STATE OF CALIFORNIA

NATURAL RESOURCES AGENCY

CALIFORNIA ENERGY COMMISSION

In the Matter of:	)	
	)	Docket No.
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CALIFORNIA ENERGY COMMISSION

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P R O C E E D I N G S

10:07 A.M.

MR. SHIRAKH: I think we're going to get started. So, I'm Mazier Shirakh and to my right is Martha Brook, we're the project managers for the 2013 standards.

And today, April 11, we're talking about some residential topics. And I think you've all seen a copy of the agenda. So I'm going to have a brief overview and then we'll start with the main topics of the day.

You know, most of you have been here before so I'm going to dispense with the logistics and all that.

There are some goals and policies that drive the building standards, and what's on the screen here basically lists some of the legislation, or executive orders, or policy statements that drives the building standards for the 2013.

And a few of them are mentioned here, the 2008 CPUC/CEC Energy Action Plan, the 2008 California Resources Board Climate Change Scoping Plan, and others.

And there are a number of executive orders signed by Governors that direct the standards to achieve certain goals related to greenhouse gases, and drive us towards the Green Building Standards that were actually published in July of 2008, and published in 2010, which codifies the "reach" standards as an energy efficiency goal as compared with the base standards.

There's also a policy document by Governor Jerry Brown, with a link that's -- it's there and that supports, you know, the goals and policies that we're trying to achieve through the building standards.

And the main goal would be the zero net energy goals for both the residential and non-residential buildings.

For the residential buildings, the goal is zero net energy by 2020 and for non-residential buildings it's by 2030.

Standards have been getting a lot of help and support from our collaborators. First and foremost is the PGC fund, the Codes and Standards Initiative, the CASE initiatives that are being supported by Pacific Gas & Electric, San Diego Gas & Electricity, Southern California Edison, and the Southern California Gas Company.

They also get a lot of support from the PIER project here at the CEC, they support our research-related topics in support of the standards.

And we also get a lot of input from the general public, which is always very useful.

This and the next graph are the famous Rosenfeld Graphs that demonstrates the impact of appliances and building standards within California. And, basically, the story here is that before 1976, when we did not have the building standards or the appliance standards, the slope of the lines, the green line representing California, the red is the U.S. average, pretty much tracked each other.

And then what happened was in 1976 was the introduction of the first appliance standards and in 1978 was the first building standards. And then we've been updating the building standards periodically since then.

And as you can see, the average for per capita for California has remained essentially flat since that time, where for the rest of the country the averages has been increasing per capita.

And, you know, we like to think that most of this is actually attributed to the buildings and appliance standards.

This next graph shows the per capita energy consumption, this is metered consumption at a building, and shows California being actually the most energy efficient state in the whole country.

While we use just under 7,000 kwh per person, per year, the U.S. average tends to be just under 13,000.

And the worst state here is about, I would say, 32,000, so there's a significant difference.

Again, the goals are to get to zero net energy by 2024 res and 2030 for non-res, and for res there's going to be two more cycles of building standards, and so the -- we're going to have to achieve big energy savings goals for each step of the standards between now and then.

And as I mentioned before this -- from starting with this cycle of standards, you know, we're going to have the "reach" standards in part 11 of the code.

And we're also lining our timelines for the first time, you know, with the rest of the building code, all of Title 24. Our standards is part six and the whole code is Title 24 that has, you know, 11 parts.

So, beginning with this round of standards, it's all going to be published at the same time, which actually puts strict limits on our timelines and, you know, the flexibility that we had in the past because, you know, we have to kind of move along at that speed.

MS. BROOK: We're not sharing the -- just hold on a sec.

MR. SHIRAKH: We're having a little difficulty with our audio/video, it takes a moment to solve it. Thanks.

So, we're trying to achieve certain goals with this round of standards and one of them is to simplify the standards as much as we can.

And some of the things we're attempting to do is migrating some prescriptive requirements into mandatory requirements. And the comments we've heard from building departments is they think mandatory requirements are clear, they're there, and if they know it's always there, you know, they can enforce it.

The problem with prescriptive measures are, you know, they can be traded off so that one doesn't know when, actually, they do have to follow those prescriptive requirements are in areas where there's multiple climate zones, and the requirements vary from climate zone to climate zone, and then it becomes less clear what each requirement -- the requirements are for each climate zone.

We're also reviewing a list of our exceptions and exceptions do exist because of good reasons, but they also introduce complexity into the standards. And many of them may have outlived their usefulness so, you know, we are going through these exceptions and eliminate the ones that we think are not necessary any more.

We're trying to create user-friendly forms and, you know, the forms are always a source of complaint because of their complexity and just the number of forms.

So here is an attempt to actually generate the software, some interactive software that would ask a series of questions and the user would, you know, fill those fields and the software will figure out, you know, which forms are needed and which fields.

So, instead of getting a stack of forms, you just get two, or three, or four forms that are needed. It's not unlike some of tax software that's out there and people are using right now to do their taxes. You don't need to really know -- need to know much about the federal income taxes to use this software, all you need to know is how to answer the questions.

And another project we're undertaking is to simplify the interface for our compliance software to allow the user to actually specify what area of the building, which components they're interested in. This could be only, let's say, cool roofs versus some building envelope measures, and you can specify that and the software will neutralize the other fields.

So, this will come in really handy for addition and alterations projects.

Improving and expanding third-party verification acceptance testing is another thing we're doing. And improving our electronic recordkeeping and creating a central CEC repository to store all the compliance documentation for future enforcement action or program evaluation, which would be accessible not only to CEC, but other governmental agencies and utilities, or maybe even public at large.

Consider measures that integrate efficiency and demand control. The best example of that is the control of ballast initiative.

We're also evaluating or considering projects that are not directly energy related like, you know, greenhouse gas emissions, impact of the cool roof on the so-called urban heat island, and some other projects that are similar to that.

For the first time we're considering water savings directly, that are not related to energy as part of the standards.

For the first time we're considering Rooftech insulation in residential buildings, which would probably be one of our biggest energy savers.

We're trying to encourage proper building orientation, probably as a compliance credit.

And we're going to consider introduction of photovoltaic systems, solar photovoltaic into the standards as an options of complying with standards on there, some limited, but important circumstances.

And most notably would be -- and there currently in the standards limitation on the west-facing glass for residential buildings and there's also a 20 percent limit on the overall percentage of the fenestration as a function of condition floor area.

So the idea here is if somebody wants to exceed those limits they can, but they have to make it up either through energy efficiency measures, additional measures, or PV, or a combination.

So there's a few other examples of where we can use this approach and we're pursuing that.

This is the timelines for the 2013 standards. You know, we're kind of in the middle here, where we're in the April to July timeframe, where we're holding our staff workshops for both nonresidential and residential buildings.

And then later on this year we're going to move into the rule-making phase of the process in the fall, and publication of the 45-day and the 15-day language.

The adoption date of the standards is currently scheduled for March of 2012. The publication of the standards is in July of 2013, and hence the name 2013 Standards. And effective date will be January of 2014.

The standards are updated each cycle. The first step is always to go back and take a look at our lifecycle costing methodology and publish that in a report, which is on our website now.

And we also, this time, we have updated our weather files, which previously was done probably a couple or three decades ago. So we have generated our weather files.

We have updated our time-dependent valuation, TDV values for both the base and the "reach" standards to reflect the current value of both electricity, natural gas, and propane. Well, that's -- yeah.

And then, again, the whole lifecycle costing methodology has been updated and published.

Before 2013 cycle the entire process from beginning to end was handled by the Energy Commission through the series of staff workshops, and we generally had 15 to 20 days of workshops.

This time we're doing things a little bit differently. Over the past year and a half the California IOUs have been holding many, many meetings throughout the State to present the proposed changes to the public and stakeholders, and trying to incite the comments from them.

And it appears that the process has been working pretty -- pretty good so far. And now we're kind of winding down the stakeholder workshop process and starting up the staff workshops. We anticipate seven or eight days of workshops this spring, in the next couple of months, to present the draft language.

And this is the list of the staff workshops that are proposed for the next couple of months. We already had the April 4th workshop, which was last week, that was the residential and nonresidential lighting topics, which was attended much better than today's workshop, for some reason.

Today is the nonresidential ventilation, boilers and data centers.

Next week is going to be nonresidential acceptance testing, design phase commissioning, refrigerator warehouses, supermarket refrigeration, solar-ready buildings, and solar water heating topics. And Martha Brook is going to be in charge of conducting that workshop next week.

And then on the 27th there will be a nonresidential HVAC cooling towers, the VAV systems, the energy management control systems, reheat systems, and air compressors workshop.

And May 5th, 2011 is the last nonresidential, mostly nonresidential topics, which is water heating, space heating, radiant cooling nonres envelope measures, including roofs, walls, and fenestration topics.

And there will be a residential domestic hot water topic presented, along with a nonres hot water system.

And May 4th -- May 24th, 31st, and June 9th are going to be the three residential workshops and we have a tentative schedule or agenda for these topics. We haven't published them, yet, but we'll do that as soon as, you know, we finalize the list.

You know, every -- with every cycle of standards we have to do certain things before the effective date and one of them is to get our compliance manuals in line about six months before the effective date, and the other challenge has always been the software, document-compliant software, make sure they're ready.

And I'm going to turn this over to Martha Brook for a quick update on that one.

MS. BROOK: We have two RFQs, which are requests for qualifications for technical support services, out on the street now. And we are using that -- those solicitations to request help on software development for our compliance software efforts.

Do you want to just go to the next slide?

And we anticipate having those contracts started this summer and we're trying to get the compliance software for 2013 standards as close to the adoption date of the standards as possible.

And the schedule is up on the screen right now, so at the end of 2012 we're hoping to be in a place where we can distribute compliance software to the public.

MR. SHIRAKH: Thank you, Martha.

And any comments related to topics that are going to be presented today should be going to me, and here's the contact information for me, the e-mail address. And we appreciate getting all the comments related to these topics by next Monday, April 18th.

So that concludes my presentation. And, again, just going through the agenda very quickly, at 10:20, which was seven minutes ago, it's going to be the acceptance testing for outside and demand control ventilation by Jim Meacham, from CTG Energetics.

At 11:00 o'clock it's going to be flue dampers, parallel positioning controls and VFDs for process boilers, and Matt Tyler from PECI is going to present that one.

11:35 will be the data centers and Jeff Stein, of Taylor Engineering, is going to present that one.

At 12:30 we'll break for lunch. And these times are approximate, we're probably going to be deviating from that somewhat.

And then at 11:15 [sic] the first topic in the afternoon is going to be laboratory exhaust system, Mark Hydeman, from Taylor Engineering, will be presenting that.

At 2:00 p.m. is going to be commercial kitchen ventilation and Jeff Stein will present that one.

At 2:45, Garage CO sensors and, again, Jeff Stein is going to present that one.

And then we'll have a -- we'll have a public comment period and then we'll adjourn around 4:00 o'clock.

At the conclusion of each presentation there's going to be a time period where -- for discussion, people can come up to the podium and ask questions. And we ask that when you come to the podium each time to identify yourself, because this workshops is being recorded, and there's going to be transcripts available, and it would be very helpful if you give the court reporter a business card, so he can have the correct spelling of your name and your affiliation.

And there's also a sign-in sheet outside, it would be nice if you signed in or stapled your business card to it.

So with that, we're going to go to the first topic of the day and Jim Meacham is online and is going to present this remotely.

Jim, are you there?

MS. CHAPPELL: Excuse me, Mazier? Cathy Chappell, Heshong Mahone Group. Are you taking questions from your presentation?

MR. SHIRAKH: Yes.

MS. CHAPPELL: Now or later?

MR. SHIRAKH: Yeah, I am.

MS. CHAPPELL: Has the Energy Commission determined the schedule for discussing -- having a workshop for the "reach" standards, specifically?

MR. SHIRAKH: Martha says no.

MS. CHAPPELL: Okay.

MR. SHIRAKH: When we know, we'll let everyone know.

MR. MEACHAM: Can you hear me now?

MR. SHIRAKH: Yes.

MR. MEACHAM: Great. Sorry, it looks like I was muted for a while.

So, can we get the presentation started?

MR. SHIRAKH: Can you see it on your screen?

MR. MEACHAM: Yes.

MR. SHIRAKH: Okay, yeah, you can start.

MR. MEACHAM: Yeah, you'll have to do it there locally. I don't have control, unless you want to give me control.

MR. SHIRAKH: Yeah, let's give him control.

MR. MEACHAM: Are you going to give me screen control or do you want to just run the slides from there?

MR. SHIRAKH: We'll just forward it.

MR. MEACHAM: Okay, yeah, that's fine.

Okay, so we were focused on three main areas, one was acceptance testing requirements related to outside air and ventilation.

One was looking at demand control of ventilation systems acceptance testing requirements for demand control ventilation systems.

And one was looking at the potential for reducing ventilation rates after economizing cycles as a potential way to reduce energy usage.

The latter one, the initial studies that we presented at the first and second stakeholder workshops, showed really no potential energy savings for reducing after economizing, primarily due to the low differential temperatures during post-economizing periods, so there’s no resultant co-changes that have come from that.

So, here we’ll be focusing on the outside air and demand control ventilation acceptance testing and compliance manual related issues. So we really won’t have any code changes, it’s really focused on the acceptance testing forms and compliance manual language as an outcome of the studies that we’re going to be presenting.

And so we should be able to move relatively quickly through all of these. And we’ve coordinated all of our acceptance testing changes with all the other authors so, hopefully, we have a streamlined acceptance testing form changes on the back end.

So, one of the first components of our study was to do a field study of ventilation performance testing for demand control ventilation systems. We examined multiple methodologies for determining air flows in situ, using multiple technologies.

And what we found was the hot wire anemometer and velocity matrix, which is a pitot tube-based device, really are the best or most accurate performers.

Two key notes that are going to influence some of the compliance manual language are that the velocity matrix is really not good for low flows, as with any pitot device, and the hot wire is more accurate at those low flow -- low air flow velocities.

And we can go to the next slide.

Some of the other conclusions, obviously, flow hood was ruled out because of the additional pressure drop that it induced, which tended to make the flows more than 30 percent low.

We didn't try fan-powered hoods primarily because it's not a common field device that should be used for outside air testing and it's difficult in some configurations.

And ruling out the ability to use the temperature splint method because of the air stacking on supply flow measurements that you'd have to do and the large Delta-Ts that are needed to make that accurate.

Next slide.

Now, what we found from all the testing results looking at, I think, over 33 systems was pretty significant deviation from the Title 24 outside air requirements and what we found in the field and actual systems, and in general were significantly over-ventilating across all systems. Although, what we found was the built-up multi-zones were over-ventilating more than the package multi-zones and the single-zone systems, which commonly have just a fixed minimum damper for outside air control were over-ventilating the most.

One interesting finding is that within this -- these different system types, we found for the multi-zone systems, built-up and package, we found two different types of controls implemented. One is the dynamic controls, which we're talk a little bit more about, or required 2 point or some other dynamic control mechanism required in the compliance manual and acceptance tests, but not often implemented. But we see a significant difference between the performance there where the -- those systems with the dynamic controls, of course, have significantly less over-ventilation than those that are using, obviously, the fixed minimum damper position. So, we'll talk a little more about that.

Next slide.

So, the overall results are if we're looking at the Title 24 requirement, the plus or minus 10 percent, almost two-thirds of the systems that we looked at were over-ventilating relative to code. About a quarter were under-ventilating, although the level of under-ventilation was much lower on an absolute basis than the over-ventilation. And then small percentage of those were actually in that plus or minus 10 percent range.

So, the code changes that are coming out of the studies, both for minimum ventilation requirements and demand control ventilation are here. The primary code changes related to demand control is to eliminate the field-to-calibration option for CO_2 sensors in the acceptance tests and to add field verification CO_2 sensor performance into the acceptance tests. We'll talk more about that. Confirming that our systems are using dynamic control methods for outside air ventilation control, minimum ventilation control as required by the code, but not well documented in the testing forms, some changes there.

Confirming the pre-occupancy purge that's required per Section 121.

The next slide.

Verifying the -- in systems that -- the plenum systems, the outside air duct introduction that's verifying the Section 121 requirements for the location of those ducts.

Adding of guidance in the compliance manual for measuring outside air flow devices and best practices, and then correcting a mounting height update for the compliance manual for CO_2 sensors.

So, I'll run quickly through these. There's a lot of detail here that I think folks can dig into more, if necessary, into the actual language for the compliance manual and the testing forms, but we'll try to focus on the testing forms and then move quickly through the compliance manual language.

So, as I mentioned, we want to eliminate the C)2 sensor field calibration block and go to only factory calibrated certified systems. And so there's some changes associated with the testing form on the construction inspection block of MECH-6A, and documentation that all CO2 sensors include factory calibration certificates, and removing the field calibration option.

And then the commensurate compliance manual language to note that field calibration of CO2 sensors is not compliant, that sensors must be factory calibrated.

The next slide.

So, at the same time we want to also add -- when we're eliminating the calibration, the field calibration, we want to add a field verification option. And this is because we've noted, and multiple studies have noted, that CO2 sensors can be unreliable, even when factory calibrated because of shipping issues and other -- other potential quality control issues. So there's some changes to the MECH-6A in the compliance manual that deal with adding that verification of the sensor performance once it's installed.

The next slide.

So, the Title 24, the code requirement is plus or minus 75 ppm for all CO2 sensors, and so we're saying that all sensors must be verified, so a pass/fail for each CO2 sensor, and at the same time we're also adding here a verification of the set points.

The next slide.

Again, just the resultant CO2 sensor verification block on the pass/fail.

The next slide.

Then there's the compliance manual changes that support this. One thing that we have added is additional time, expected time for functional testing for each of the sensors, so whereas the text was one to two for a time to complete, one to two hours, we've changed that to one to three to allow time for the sensor verification.

Although now that we're eliminating the need for sensor calibration, we think that there will be some balance there in that tradeoff.

One of the things that we found as a part of our field study, obviously, was that dynamic controls as expected, and why it's in the code, have a huge impact on ventilation performance and reducing over-ventilation across the range of operation of variable air volume systems. So, the protocol really isn't well outlined or really included in the MECH-2A, so we want to have some changes there on the acceptance testing form to help confirm that dynamic control.

So, we're going to change the construction inspection block, if we go to the next slide, for variable air volume systems, so this is only for variable air volume systems. We're going to add an explicit block that says fixed minimum damper set point is not being utilized to control outside air, just to make it clear that that is not an appropriate method for variable volume systems. And then actually selecting which of the methods is being used to control the outside air, again to just further verify that an appropriate dynamic control method is being used.

Next slide.

Of course, there's nonresidential compliance manual changes that -- text changes that come, basically just adding that, you know, the test is really designed to confirm the dynamic controls methods.

The next slide.

And to reiterate that fixed minimum damper set point can't be used and that there has to be some type of active controls.

The next slide.

Talking about potential ways to do that in the compliance manual, as well, and adding the new requirements for the construction inspection blocks and relating all the new MECH-2A pieces of the compliance manual.

The next slide.

And, again, reiterating the fixed minimum damper set point is not compliant.

The next slide.

Pre-occupancy purge is, again, required by Section 121, currently not in the acceptance testing form. It's only in the NA7.5.2 for single-zone and unitary systems, so we want to move that to MECH-2A and include that confirmation that the purge is configured.

The next slide.

So, we're adding a block to the construction inspection that the pre-occupancy purge has been programmed to meet the Standards 121, which is most common of one-hour start before the building is occupied.

The next slide.

So, with the compliance manual, adding the text that deals with the confirmation of the pre-occupancy purge.

The next slide.

We're also adding guidance in the compliance manual for outside air flow of measurements. And, essentially, we just want to try to reduce some of the variability and inaccuracy in the field because they are difficult measurements, so we're adding guidance for instrumentation, avoiding turbulence from wind, and from induced turbulence of -- as you're taking the testing how you measure the free area of the dampers to calculate flow rates, and averaging of and taking multiple measurements to get more accurate overall average flows.

So, that's a summary of the guidance. There's a lot of text. We talk about adding -- adding a dimension of multi-point velocity matrix, pressure type systems for testing and where those are appropriate to us.

The next slide.

And then, again, best practice guidelines. I'm not going to go through all of these, there's a lot of language that we've added in the draft compliance manual, changes that you can read but, basically, how to take the traverses, where, and how to reduce turbulence.

The next slide.

Calculating free areas, when to use certain systems and averaging of -- this is a summary of the actual compliance manual changes.

The next slide.

And then we have the verification of the outside air ducts when they're in plenum systems. So, if the return plenum is being used to distribute outside air, Section 121 requires that they're -- that that outside air supply connection is within five feet of the unit or with 15 feet and has a discharge velocity of at least 500 feet per minute. And so we're adding this to MECH-2A to have that confirmation that's currently not in the form.

And, again, the compliance manual language that goes along with that change. And that's it.

MR. SHIRAKH: Thank you, Jim.

One thing I wanted to point out is there's a lot of language here related to the compliance manual and the forms, and these are not part of, actually, the rule-making documents. Typically, we work on the compliance manual language and the forms after adoption of the standards.

But we presented this language here because we thought it was helpful for the stakeholders to get an idea of the kind of changes we're recommending.

But anything that you saw that was related to the compliance manuals and the forms is not actually a part of the standards process, and we'll work on that a little bit later on.

So, any questions or comments relating to the topics that Jim had talked about? I don't see anybody in the room. Anybody online?

Okay. So, with that, we're going to move to the next topic, which is the flue dampers, parallel positioning controls, and VFDs for process boilers. And Matt Tyler, from PECI, who's going to present this, is also doing this remotely.

Okay, Matt, are you ready? Can you see this on your screen?

It seems like Matt is not connected to our audio, yet.

So, while we're trying to bring Matt online is it possible we can go to the next topic, the data centers, and Jeff Stein's going to be presenting that? If there's no objections, I'd like to reverse those two until we figure things out how to connect Matt to this process.

Jeff, are you ready to --

MR. STEIN: Yeah, I'd be happy to. Do you want me to put my slides on a --

MR. SHIRAKH: Yeah, could you give it to Ron.

MR. BACCHUS: Do you want me to stand here?

MR. SHIRAKH: Here, come up to the podium, please.

MR. BACCHUS: While we're waiting, Jamy Bacchus, NRDC. Was there any estimated energy savings or demand reduction to the outside air DCV?

MR. SHIRAKH: Jim, are you still there?

MR. MEACHAM: Yes. Can you hear me?

MR. SHIRAKH: Yes.

MR. MEACHAM: There is a method for -- that was developed in the last round and, Kathy, maybe you need to jump in here exactly how we're applying that. But there is a methodology for the acceptance tests, themselves, but I don't believe we've done any -- we have not done any and are not, for acceptance testing changes, doing an update to that savings methodology from improved acceptance testing.

MR. SHIRAKH: What the acceptance testing do is make sure that the savings will persist and that the measures, themselves, they capture all the savings, and they assume that the savings will be there over time. And without the acceptance testing, you know, we know that the savings will kind of go away faster.

So, you know, the initial case, initially, for the work that we do for each measure actually captures all this energy savings and demand reductions that are associated with that measure.

MR. HYDEMAN: Mazier, if I may? So, if you're interested in getting the details on the acceptance test, which I was the author of, they are in the nonresidential compliance manual, I think it's NA-7, is that correct?

MR. SHIRAKH: Yeah, that's the -- actually, it's not the compliance, the residential appendices.

MR. HYDEMAN: The appendices, that's right, the residential appendices --

MR. SHIRAKH: That would be NA-7.

MR. HYDEMAN: -- NA-7. And I can give you an actual citation, but we went through two rounds of this.

So, we started the acceptance tests for DCV in 2005, we enhanced them in 2008. And there was a lot of people involved in that, so it had a lot of eyeballs.

MR. SHIRAKH: Okay, I think Jeff is ready.

MR. STEIN: So, I wasn't sure exactly what to present, prepare for today. What I have here is I have both the report available -- our full report, so we can go through any portion of that we want to look at.

I also have a set of slides from one of the public meetings that we've had. We've had, in addition to the stakeholder meetings, Mark Hydeman and I have gone out of our way to publicize what we're doing, proposing in Title 24. Mark's presented at some of the data center conferences, I presented at the last ASHRAE National Meeting in Las Vegas. And these are some slides from a presentation Mark and I gave at the Energy Center, just a public presentation on a range of topics on what's on the horizon for Title 24, 2013.

And so these are the slides that I presented there and I was going to run through these, but I'm happy to switch to the report and go through it in detail, any sections that anybody wanted to talk about.

Anyway, just a little background on how data centers are covered in Title 24, it's been a little bit of a gray area of whether data centers are covered or not under

Title 24.

There's a process space exception in Title 24, but data centers clearly don't fit under that because they're not typically conditioned to less than 55 or greater than 90.

There are some exemptions for process loads to specific sections, but there isn't -- and there's an exception in particular that's called out for computer rooms and telecom rooms for the economizer requirements if you have poor air quality, somehow.

But in general data centers, as far as I read it, are covered to a large extent, except where there specific exceptions.

Nevertheless it's been the common interpretation, I think, frankly, that data centers aren't covered in Title 24 and have largely not been subjected to Title 24 as a use type.

So, one of the first things we wanted to do with data centers was just to make it fairly explicit that they are covered, so there's sort of two separate things that we're doing in that regard. One is, and Mark will talk about this later when he gets to the labs section, is we're creating a category of covered processes to explicitly state that the following types of processes are covered and are not exempt. And data centers would fall in that category.

And then the other thing is we're actually adding a section to 144, the prescriptive section of the standard which would be a new data center section, basically, and it would say data centers have the following additional requirements in addition to the rest of the standard.

So, we're sort of making it explicit that data centers are covered and that not only are they covered, but here's some new requirements specific to data centers.

So one of the first things we had to do, then, is to define a data center, and we're not even using the word data center, we're using the word computer room. And it's a room that has over 20 watts per square foot, basically, of equipment power density.

And here's that new section that I described, it would be the last section -- you know, the next section in Section 144, the prescriptive HVAC requirements, additional requirements for computer rooms

So, actually in the section just about this, under economizers for all equipment, we're actually going to add an exception that says computer rooms do not fall under the standard economizer requirements because they have their own separate economizer section. Just to make it clear that they didn't have to comply with two sets of economizer requirements.

These are economizer requirements that are tailored to data centers. And we’ve done a full range of analyses on different types of data centers, ranging from data centers the size of this podium to data centers the size of this building, in terms of demonstrating cost-effectiveness for all types of data centers, because computer -- a computer room, really is what we’re talking about, you know, can mean a lot of different things.

So, economizers, each individual cooling fan system primarily serving computer rooms shall include either, basically, an air or a water economizer. So we’re starting out not with a size requirement, and there are some exceptions based on size, but basically we’re starting out by saying all computer rooms are covered, period.

And I’ll get to the exceptions in a second.

Both of these air and water economizer requirements are different from how standard other mechanical systems are covered in terms of air or water economizers. The air economizer language here is different in that it does not require you to use outside air to do your cooling. It’s written such that you can do air-to-air heat exchange, basically.

So, you’re using outside air to do the cooling without the use of mechanical cooling, but you could do it such that you can use a heat exchanger if you had concerns about contaminants, or particulates, or anything getting into your data center. You can have a completely sealed data centers with a fully integrated air economizer.

And so then we had to define the temperature at which you met the full expected load and we used 55 degree dry bulb, 50 degree wet bulb, which is now quite conservative for data centers. You know, new state-of-the-art data center design supplier temperatures are often in the 65 to 80 degree supplier temperature range, so this is easily achievable with an air-to-air heat exchange kind of system.

Then, in a water economizer, the language we used was 100 percent of the load at 40 degree dry bulb, 35 degree wet bulb, and wet bulb is really the operative number there because that's what you're using in a water economizer. And that's lower than what's in the standard now, so that makes it, you could say, easier to apply a water economizer to a data center.

And the reason we did this is because the expected load is generally the full load, even at very cold temperatures, as opposed to an office building, for example, that might have a water economizer, the expected load -- the standard language or the existing language for office buildings, for example, is 45 degree wet bulb. So, it's going to be easier to meet a much smaller load with a 45 degree wet bulb than it would be for a data center to meet

100 percent of the load. So, we made it easier for data centers to use a water economizer.

And this actually was a point of contention in the ASHRAE process. We went through a similar process on data centers, as most of you probably know, with ASHRAE 90.1 2010, and there was a lot of analysis that we actually did and others, including the Trane Company, that showed that this number, the 35 degree wet bulb was easily achievable for data centers.

So that's the first part and then we get into the exceptions for economizers. So, the first exception is on size. Individual computer rooms under five tons in a building that does not have any economizers.

So, you could have a three-ton computer room or a two-ton, you know, computer room load, but you'd still have to have an economizer if you were in a building that had an economizer.

And the theory there is that a room that small could basically be a zone off of a larger system that had an economizer. And that's basically what we've been doing and a lot of people have being doing with computer closets, is really what it is, an IEF closet, a server closet, instead of putting in a split DX system, for example, in a building that's got a central system with an air economizer, put a zone into that room. You can still have a split DX system as a backup system.

And, in fact, that's the analysis that we did for this to prove, you know, to justify this as cost-effective all the way down to zero tones, effectively. We took pretty much the smallest computer closet you would have, could you justify the incremental cost of a VAV box to serve that zone, assuming that it already had a split DX system as sort of a backup at that point. And the analysis showed that it was cost effective.

So, the other two exceptions we have here is an existing computer room, in an existing building, up to a total of 50 tons of new cooling equipment per building. You know, the cost effectiveness to add an economizer gets much more difficult if you have an existing computer room. You know, the cost of doing work in an existing computer room is quite high, sometimes, when you have issues about maintaining your up time and cleanliness, and so forth, and so 50 tons was a pretty conservative number.

This also happens to be the number that the Oregon Energy Code used, so we felt like -- and also, I think this is also where we ended up with ASHRAE, as well.

So, you know, there were some comments that maybe we could make this tighter, but I think it's reasonably conservative and doesn't expose us to a lot of, you know, potential concerns that people might have.

And then the last -- actually, there is one more exception after this. But the third exception is a new computer room, in an existing building. So, you had a building and you were planning to put in a server room in the basement of the building, where you couldn't do any kind of economizing easily, you can still do that up to 20 tons, but after that you kind of got to get with the program and put in an economizer.

the fourth exception here is really sort of a clarification on the first exception. So the fourth exception basically says and, you know, we can read through the language, but I'll sort of paraphrase what it is and show you an example in a second. Basically, what this says is if you had a central system that had an economizer, you could use it to serve a computer room, you don't necessarily have to size the central system to serve that computer room, with the thinking that the central system is going to have spare capacity much of the time when you're off of designed conditions, particularly at night and on the weekend, for example, and so you don't necessarily have to over size the system. We didn't include that in our life cycle cost analysis, basically, over sizing the central system. We only included the cost of the VAV box to that zone, and you can only put that into the zone if you didn't do anything at the central system.

So we said you don't have to do anything to over size the central system as long as you lead with the VAV box, basically, for that zone. So whenever the VAV box can serve that zone great, do that. If it can't because the central system, you know, it's a hot day and you're building is occupied and it's running out of capacity, then you can shut off the VAV box, switch to your split DX system, and that's what this says in code language.

Here's an example, I don't know exactly how easy this is going to be to see what's going on here, but this is one of our designs, a project that we -- an office building we did that has a bunch of computer labs, they call them. And here's a lab that's got a chill water fan coil in it that can meet the load when the central system can't, or after hours if they -- actually, though, our requirement says you have to run the central system after hours.

But, basically, you got a VAV box serving this zone and a fan coil. And here's another zone that has a VAV box that serves that zone, as well as a fan coil. So, you lead with the VAV box and the fan coil is basically back up or when the central system has run out of capacity.

You know, probably everyone knows what an air side economizer is, I probably don't need to spend too much time on this. Just some examples, this is a Microsoft Data Center where they're using air economizing.

This is one of the many technologies that are now available to use air side economizing without outside air. This has got an air-to-air heat exchanger on it. This is actually called a Kyoto Wheel, I'm not sure why. I think probably somebody from Kyoto came up with it.

Here's another air-to-air heat exchanger. This is an indirect evap cooler and this is becoming more common in data centers to use indirect evap cooling. Again, so the outside air is the scavenger air and never actually comes into the data center.

Here's an integrated water economizer. Here's an integrated water economizer on an air-cooled plant. You know, one of the comments that people made as well, if it's a really large data center you can't put an air economizer on it cost effectively, and if it's air cooled, you can't put a water economizer. Well, actually, it turns out you can pretty easily put a water economizer on it. There is, you know, some more cost for the cooling tower, but it can be done.

As I mentioned a moment ago, the current Title 24 wording on water side economizer is at 45 degree, you know, 50 dry bulb, 45 wet bulb for a computer room. We're relaxing that to 40 dry bulb, 35 wet bulb.

My slides are a little out of order, I'm going to go back to that one in a second.

So, this is the analysis that we went through with ASHRAE to justify that. And I don't know if we want to get into all the details here, but one of the things to take away from this is, yes, the computer room load is still at a hundred percent, theoretically, at, you know, 35 degree wet bulb. But when you're on water economizer, you don't have the heat of the chiller to reject, so that's typically 15 to 18 percent of the total load on your cooling tower system, anyway, so now you have more capacity that your cooling tower system can provide.

And then the other thing is most data centers have some amount of redundancy, either in air-handling systems and/or cooling tower systems. So you can take credit for all that redundancy and have effectively a larger cooling tower system that will get you closer to the ability to meet a hundred percent of the load.

This is that slide I skipped. And it's just a quick comparison of where the Title -- where our proposed requirement lands relative to some other codes that are already on the books.

ASHRAE 90.1, Oregon Energy Code, and Washington Energy Code, and we're basically somewhere in the middle, to sum it up. ASHRAE put in, you know, a data center-specific economizer requirement, but then there's a bunch of exceptions. One is on climate, and then one is if --

actually, if any data center under 250 tons, without a chill water plant.

No one had done the analysis to show that you could put in an air-to-air heat exchanger and still have a cost-effective system. And there were folks, some of who sell gas phase air filtration, who were making the argument that, you know, you can't have outside air in data centers without expensive equipment. So, we sort of lost that battle and it basically was such that the thinking was, well, we'll only require it where you would put a water economizer in cost effectively.

So, for Title 24 we went back and did the analysis and showed, easily, that you can show an air economizer as cost effective, even if you were concerned about particulates or anything, and we did the whole analysis with an air-to-air heat exchanger.

Oregon is fairly similar to California, they stopped at four and a half tons, up to 20 tons per building.

Washington is actually, I would argue, stricter than California. It's a fairly complex code, so I don't want to claim to understand it fully. But, basically, my understanding is that it requires air economizers in all data centers, with few exceptions, so even a water economizer wouldn't meet the Washington code at this point. Anyway, I thought that was interesting and somewhat useful for a comparison.

The next piece of the proposal has to do with humidity controls. We're basically prohibiting re-heat in data centers. And it isn't particularly common, now, in new data centers, but not long ago it was common to see re-heat because of the need to -- or the desire to maintain tight humidity control. Re-heat would only be necessary if you didn't have enough of a load in your data center, that your cooling system would naturally get you to a certain upper humidity amount.

Anyway, you know, basically from our definition of a data center you already have enough load that your coil is going to provide de-humidification. And we've also, from our research, found that there is no need for humidification or de-humidification in a data center.

Rather than prohibit humidification, we're prohibiting non-adiabatic humidification. Steam, infrared types of humidification that are adding significantly to the energy intensity, but allowing adiabatic humidification because it doesn't, in fact, increase the cooling load and in fact decreases the cooling load, so it's beneficial humidification from that regard.

And it is used quite a bit, one, as an energy efficiency measure, but also for data centers that still want to hedge their bets and maintain a humidity range, it allows them to do so in a way that doesn't sacrifice energy.

A little bit of background on where we landed on the humidity issues. ASHRAE does, in their Technical Committee 99, you know, recommended data center conditions still have some humidity requirements, and that was still sort of the big stumbling block.

But we have done our own research on the subject and found that there's no published research supporting the need for humidity control in data centers, it just isn't out there.

And that there is a number of organizations who are actively promoting not controlling humidity in data centers. The NEBS, which has standards for telecom central offices, doesn't. And the ESDA Association has a standard for protecting equipment from electrostatic discharge and they don't allow humidification as a means of control for ESD.

And this was the argument that's often been used is that data -- that humidity control is necessary to prevent electrostatic discharge. And we all know that if you walk across the carpet in dry, you know, conditions, that you'll create a shock.

Well, what Mark Hydeman and Dave Swenson, the president or ex-president, I guess, of the ESDA Association talk about in this article that they published in the ASHRAE

Journal is that all computer equipment that's sold commercially, nowadays, has the CE stamp on it, which is the European Union sort of UL listing. And if you turn it over -- well, this isn't a computer -- you'll see it on there. And what that means is that the equipment has already been tested at certain -- to be resistant to certain charge levels. And it's been tested to be resistant to any charge level that a person can actually generate with any humidity level.

So, yes, a person can generate more humidity in drier conditions, but not enough to damage the equipment.

Conversely, what Swenson and others have found is that if you open a piece of equipment to work on the mother board, for example, that there isn't a humidity level at which you will not damage the equipment.

So, even if you controlled humidity in a space, you would only be giving yourself a false sense of security that you were going to not damage the equipment, because a person will always generate a charge level. We can't always sense them, but there is always a charge level being generated by a person.

And so that's why the ESDA Association actively is not including humidification because they have found that the only way to really prevent that kind of damage, when you have an open piece of equipment, is to use things like wrist grounding straps, and I guess they have some other options.

But, anyway, based on all this we felt pretty comfortable and justified limiting the humidification options for data centers.

And, frankly, I haven’t had any feedback from any of the stakeholders on this at this point, or negative feedback I should say.

I don’t know how I am on time, am I going too fast, too slow? I’m kind of somewhat halfway through here, I think.

MR. HYDEMAN: Jeff, if I could just weigh in on that, one other thing that’s really relevant on the humidity side is that the NEBS standard, which covers central officer facilities for telecom, which has exactly the same equipment that we have in data centers, has no lower humidity limit, hasn’t forever.

MR. STEIN: Right, it says that right here.

MR. HYDEMAN: And they use personal grounding.

MR. STEIN: Okay. The next part of the data center-specific requirements is on fan power. There are some fan power limitations in Title 24 right now. They’re generally based on ducted overhead systems with terminal units, so not necessarily appropriate for single-zone systems without zone control, which is what you would see in data centers.

And those systems typically have much less pressure drop because they're often quite close-coupled. You know, you don't typically have a central system on a roof, you know, serving data centers on multiple floors, I mean when you get to a real -- a real high load data center.

And so we sort of did a survey of what kind of fan power was reasonable for a data center and came up with the 27 watts per KBTU of sensible cooling capacity. And one way that you would be able to achieve that kind of load is with a 20-degree Delta-T on your air side system, a two and a half degree pressure drop on your fan system. You know, a reasonable fan efficiency, motor efficiency. And, of course, there's many other combinations of air side Delta-T, you know, total pressure and fan efficiency that could get you there.

And the requirements in watts per KTBU, as opposed to watts per CFM, because we wanted to encourage people to use higher air side Delta-Ts and, conversely, discourage low air side Delta-Ts. You know, you can put in a larger and larger fan system if you do a fairly poor job of containing your data center, for example, but wanted to sort of discourage that and go in the other direction.

And one of the things we wanted to make clear, and this will obviously come up in the user's manual, is that the calculation can account for redundancy. So even if you had a system that couldn't meet the 27 watts per KTBU at design conditions, but you had redundant equipment, you could operate all of the equipment simultaneously and then the fan power would follow the infinity laws and you'd be able to easily get under the 27 watts per KTBU.

So, this is the survey of a bunch of data centers that we surveyed and found that it was pretty easy to meet the 27. In fact the only one that didn't was a crack unit that had both a DX coil and a condenser water coil in a series with each other, and was run at a relatively high speed. The same coil, if you just backed it off a small amount, in terms of the design air flow, could get you under the 27 KTBU.

And, frankly, one of the main reasons we put in this requirement is we don't expect this to apply -- as we've seen it, it doesn't really apply to a lot of data centers now, so it's not like it's going to be changing a lot of the current practice.

But the thinking was down the road, in the future, as people try to do things to improve air side economizing, for example, putting in air-to-air heat exchanger, we wanted them -- there to be some sort of minimum efficiency level in terms of fan efficiency, so you couldn't put in a system that had an air economizer on it, but had five inches of static pressure across it, you know, and didn't -- you know, and basically lost the value of that economizer by using and, you know, resulting in a higher fan -- fan energy. So, this is sort of a little bit of a hedge against potential bad designs down the road, as more than eliminating what we see as bad design today. There aren't a lot of designs today that wouldn't really meet this.

The next section is on fan control. So, just a little background, in Title 24 right now there is a single-zone VAV section that says effective, it's starting next January, both direct expansion and chill water systems over ten tons shall be variable air volume, either with a variable speed drive or a two-speed fan.

Data centers, you know, will be covered by this, but we wanted to go a little bit further with the requirement for data centers. And, frankly, we're also going further than this for other systems as part of a separate proposal. But we wanted, again, to have a data center-specific section on fan control, or variable speed control of the fan.

And so this is that, the language that we're proposing, which is that each unitary air conditioner with a mechanical cooling capacity over 60,000 BTUs, which is about five tons, and each chilled water fan system of any size shall be designed to vary the air flow rate as a function of actual load, et cetera.

So, basically, you're going to have to have variable volume control on all chilled water systems and any DX system over five tons.

And we've done a series of life cycle cost analyses, both for DX and for chilled water system, to justify this. Obviously, for a chilled water system we had to assume some minimum size because you can't have, you know, a 10 BTU system and justify the cost of a variable speed drive, so we came -- I think we basically solved for the smallest size that would justify that and it was, you know, something like a -- well, actually, we did it in motor horsepower and it was something like a 12 horsepower motor. We felt like at that point we could basically say all systems we could justify it.

This is some information on currently available DX equipment. So, you know, one of the concerns is that, well, that's going to be a big change for manufacturers and they won't necessarily be able to meet that any time soon. And it turns out that there's a lot of manufacturers that already have variable speed either as an option or are using EC fans, which are inherently variable speed, already, and then have compressors that are either already multiple-step or variable capacity. So, it isn't really going to be a problem for finding products.

There certainly are a lot of products out there today that don't meet this. In fact, most DX equipment going into data centers don't meet this. But there are products from at least half a dozen manufacturers today that meet this and by the time this code goes into effect in 2014, it will be certainly more products available.

Just some of the literature from one of the manufacturers on their energy performance of their variable speed fan, with a digital scroll, compared to things like a fixed speed fan, with a single-stage scroll compressor.

The next requirement has to do with containment and I'll just read it. "Computer rooms with air-cooled computers in racks and with a design load exceeding 175 KW per room, shall include air barriers such that there is a significant air path -- there's no significant air path for computer discharged air to recirculate back to computer inlets without passing through a cooling system."

So, containment was fairly unheard of until, I don't know, maybe five years ago in data centers, and now it's pretty much become the standard practice as the data center loads continue to go up. But also, as people recognize the tremendous inefficiency and even functional problems that happen with data centers that don't have any sort of containment, where you have computer room air conditioners that might be serving a raised floor, but then computers that are overheating because the air that comes out of the computer gets circulated back into the computer. And then what ends up happening is you need to overflow the airflow from your air handling system and over-cool it. And it's, you know, a pretty inefficient way to do conditioning.

It also turns out that containment is cheaper. You know, you would think that adding things like strip curtains, or Plexiglas covers, and I'll show you some pictures, would add to the cost of a data center, but it turns out it actually reduces the overall cost because the mechanical system doesn't have to be as close coupled.

You can eliminate the raised floor, for example, in the data center, you don't have to provide cold air directly in front of each rack if you can contain your system and provide cold air, for example, by dumping it in one side of the room and letting the racks pull it in, you know, draw it through the containment system and back to the air handling system.

So, that's why it's pretty much caught on, I would say like wildfire in the data centers, that it saves energy, allows it to actually operate at the loads that they want to operate at without overheating, and it reduces the first cost.

So there are some cases where we want to provide exceptions. The first is expansion of existing computer rooms. If your data center wasn't designed for containment, it can be quite expensive to retrofit it, particularly having to do with things like fire protection. If you put in partitions between hot aisles and cold aisles, for example, you have to make sure you have sprinkler coverage in the hot aisles and the cold aisles.

And to retrofit a sprinkler system in a live data center is often frowned upon.

And so we just wanted to cut that out as a requirement, it's not going to be required. It's done quite frequently and, in fact, we got a bunch of data from PG&E from their incentive program about how cost-effective it was in the cases where they had done it. But that, of course, didn't cover the cases where they didn't or it wasn't cost-effective.

Anyway, the second exception is computer racks with a design load less than 1 KW per rack. If you have a low-density room, you know, 1 KW per rack, you could still have a hundred watts per square foot in your computer room pretty easily. But it's still a relatively low density and at that point containment is often not necessarily cost effective. And often your data center would then not necessarily even be in a hot aisle/cold aisle arrangement, which is something you generally need to do containment.

You know, the data centers that we're working on nowadays are, you know, 10, 20, you know, even 40 KW per rack at this point, so one is not -- is not a whole lot, anymore.

And then we left a performance option using CFD. You know, one of the comments that we had gotten was, well, I’ve found from my analyses that I can put in a cold aisle containment system, but I don’t need to put a cap on it if I’m doing under-floor supply because the air just sort of puddles in like this bathtub in the cold aisle, and putting the cap on it didn’t save me any energy, or any money, so I didn’t need to do it.

You know, I’m still skeptical, but if you did an analysis and it showed, you know, it seemed reasonable to have a performance option there.

MR. SHIRAKH: Jeff, can you go back to that slide?

MR. STEIN: Yep.

MR. SHIRAKH: In that exception number three is the kind of language we like to avoid because it’s really vague. I mean, how does that building department enforce something like that?

MR. STEIN: Oh, I think the language -- you’re right, the language does need to be cleaned up. I mean, do you have a -- you know, a concern with the option, at least, of a performance alternative or should we just leave that for the whole --

MR. SHIRAKH: No, I don’t have a problem with the performance --

MR. STEIN: Okay, so it’s the language that needs some work.

MR. SHIRAKH: -- it’s just there can be potential fluid dynamics or other analysis, I mean that just seems --

MR. STEIN: Yeah. I mean, probably, we would say something like -- I think there’s some language in a few other places that’s -- where it can be shown to the satisfaction of the HJ that the proposed design, you know, provides similar energy performance, or something. We’ll work on some language.

MR. SHIRAKH: Yeah, okay, thanks.

MR. STEIN: And I think there’s some cases already in the code we can draw from.

MR. SHIRAKH: You have a question? Can you come up to the podium?

MR. BACCHUS: Jamy Bacchus, NRDC, again. I’d point out that the significant path is kind of vague, I’m still curious what you’re doing there?

MR. STEIN: Yeah, we struggle with the language. It’s going to be hard to define it in a while lot more specificity because there’s so many different options out there, and I’ll show you some examples of what containment is.

It’s kind of the thing that you kind of know it when you see it. I mean, the folks in the data center world have a pretty clear picture of what it means to have a contained versus an uncontained data center. You know, if you ask somebody is your data center contained or not, they could say yes or no pretty quickly.

And so, yeah, I could potentially see some enforcement issues. You know, is a cable cutout fully grommeted and a horse, you know, hair collar, and is that -- you know, what -- I mean, we could maybe come up with some sort of leakage rates.

But I think at least as a first stake in the ground, this is actually the first code that I've seen that has anything like this. So, as opposed to like the economizer requirement that's different from Oregon and Washington -- I mean, it isn't very different from Oregon and Washington. We're the first to cover this ground.

So, I mean if you've got ideas, maybe --

MR. BACCHUS: Maybe just get rid of the word "no path" but, yeah, you're going to have holes for cables that you were saying but --

MR. STEIN: Right. Saying "no path" I could see some HJ, who wants to be a real, you know, stickler about things, making life miserable, particularly somebody who hasn't -- doesn't have experience with what it means to be contained.

Mark, did you want to add something?

MR. HYDEMAN: Yeah. First of all, we're willing to reach out to try and get some help with this. There's some very sticky problems. You know, one is where you draw the boundary, and Jeff has tried very hard to make it a reasonable boundary. We've got, for instance, exception two for low-density racks, and we were talking on the way up maybe of increasing that.

There's some equipment in the data center floor that's freestanding and there's nothing that you can do to contain it, it's just the way it is. A lot of the telecommunication and switch gear just stands out in the floor.

But then there's also all sorts of configurations of disk drives, and memory, and that sort of stuff, some of which you can contain and some of which you can't.

And so it's very hard to draw this boundary, but we have lots of contacts within the industry and we can kind of reach out to them to try to figure out a consensus language that works.

Q Thank you, Mark. Well, if you want to --

MR. HYDEMAN: Just a follow up?

MR. SHIRAKH: It's a follow up to this issue?

MR. HYDEMAN: Yeah.

MR. SHIRAKH: Okay.

MR. HYDEMAN: Well, it’s the 175 KW per room. If you use your 20-watt-per-square-foot, that’s around 9,000 square feet, almost, which seems fairly large. I’ve done containment --

MR. STEIN: Twenty watts a square foot is --

MR. HYDEMAN: Is your definition for a computer room.

MR. STEIN: Right. But you wouldn’t have a -- typically, when you have computers in racks --

MR. HYDEMAN: Yeah.

MR. STEIN: -- which this is over applying to computers in racks, you’re going to be way above 20, you’re going to be more like 200 to 400, so the size of the room is pretty small.

Granted, the 175 was a somewhat arbitrary --

MR. HYDEMAN: That’s what I was asking about is where --

MR. STEIN: Yeah, it was a fairly arbitrary number and it was picked to cover basically big data centers, not necessarily things like small server closets.

You know, 175 KW, I can’t remember, it’s like 50 tons. I can’t do the math that fast in my head. Is that right, John, you’re faster than me?

But it’s not a very big data center. You know, big data centers are, you know, five megawatts. And so we're covering sort of the pie of energy that's out there. You know, this is probably capturing most of it for sure.

MR. HYDEMAN: I was just curious if there was --

MR. STEIN: There was a lot of the --

MR. HYDEMAN: -- an area threshold, three, four hundred square feet that you found that containment was cost effective?

MR. STEIN: No, as we said, this has got a negative first cost as far as we can tell, so the -- but that assumes that there's some sort of fixed cost involved in doing the analysis, and finding the manufacturing, collecting the product, you know, doing installation. So, we didn't do a whole lot of life cycle cost analysis. We basically said, if you've got a large data center, the ones that are out there, you know, everyone is telling us it's saving them money to put this in right now, and they're not having to duct their systems.

If you have a tiny, little room, you're not going to duct it, anyway, you're going to have a unit pretty much just sitting in the corner that's conditioning the room.

So at that point there probably is some first cost and we'd have to go through a life cycle cost analysis, come up with some numbers.

This sort of allowed us to basically say, okay, we're covering large data centers where it's clearly lower first cost and operating cost and, you know, getting us most of what we could possibly get.

When you get into like a little server closet, and IDF thing, it gets much more -- it's a little stickier, and so that's sort of why we said let's start with big stuff.

MR. SHIRAKH: Thank you. John McHugh, did you have a question, and then David Ware.

MR. MC HUGH: This is an outstanding proposal. I was involved in a project that it was probably about this sort of size, and it's kind of ironic, you know, it's one of those simple things that probably works at every size computer room, and the solution was pretty simple, as well. And it's almost so simple you kind of go does this even need to be written in the Energy Code.

So I'll just throw it out there, which is I did a before and after evaluation of this system. Someone put together a very fancy CFD model, but at the end of the day the primary solution was that they essentially stuck things that were essentially glorified sponges in the holes that were cut out in the floor tiles for where they cabling was coming up, so they're basically uncontrolled floor tiles. And, of course, what you're doing, of course, is you're just blowing all this cold air up into the hot aisle.

MR. STEIN: Right.

MR. MC HUGH: And I don't know if you've thought about something like this, but this is something that --

MR. STEIN: Right.

MR. MC HUGH: I mean for that particular case, I think it reduced the cooling load like ten percent, which just seems almost ridiculous that it was that much.

MR. STEIN: Yeah, it doesn't usually reduce the cooling load, the load is the load. It's how much fan energy you use to get there and then how much compressor energy you use to get there because you had to run it at a lower temperature.

MR. MC HUGH: Right.

MR. STEIN: But the load is going to be about the same.

MR. MC HUGH: Right, the load is the load, but I mean the actual energy consumption of the cooling system.

MR. STEIN: Yeah, and a lot of that, it sort of wraps all up into that word "significant," and where that significant is going to get discussed is in the user's manual. And, you know, we could easily put in chapters and chapters in there about what it means to do containment, and how to cover, to deal with things like the floor --

MR. MC HUGH: It's not even containment, though, this is just the holes in the floor.

MR. STEIN: Right, but that would be part of the containment on the --

MR. MC HUGH: Yeah, but what I'm suggesting is that you wouldn't even need to look at 175 KW, that's just a good practice regardless of the size of the computer room, that you don't have basically uncontrolled tiles, you know, where the cabling's coming out.

MR. STEIN: Yeah, I mean you're assuming, then, that you had, you know, hot aisles and cold aisles, for examples, that you had servers that drew from hot aisle and discharged to cold aisles. I mean unless we're going to get into, you know, exactly that level of design, I think it would be hard to say --

MR. MC HUGH: You've got to control where your cables are coming from, yeah.

MR. STEIN: Yeah.

MR. MC HUGH: Okay. I just thought I'd throw it out there just because it was kind of -- it seemed like a no-brainer kind of --

MR. STEIN: I mean there's a lot of good resources out there for a good design and, you know, we can throw some stuff like that in the user's guide, but I think it's hard to, without stepping on too many toes, to get into, you know, real specific design requirements.

MR. MC HUGH: Okay, thank you.

MR. SHIRAKH: David?

MR. WARE: David Ware, Commission staff, and I just want to point out something related to the semantics in what you're proposing that may cause some heartache to us as we work through the whole myriad of revisions to the standards.

And the whole premise, and it's kind of been pointed out by NRDC, of this section, it's related to data centers, large data centers, and it's talking about containment. And what predicates containment is this term called air barriers. So enforcement in the field is this thing called air barriers.

We haven't defined what that is, nor have we put any performance requirement around that, but the standards throws that term around in many of its documents that are approved through the rule-making process and support the compliance part of the standards.

So, if this thing called air barriers is what makes this piece of the proposed language work, I'm just suggesting that we make sure that we know what that means, because that's the whole critical element here.

MR. STEIN: So, we weren't intending to piggy-back on any other type of air barrier, and if we did, maybe it was a poor choice of wording. Maybe you're thinking of like house wrap kind of air barrier. So maybe we ought to come up with a different term because this is a completely different animal that we're talking about here than a house, tie-back kind of wrap.

MR. WARE: Yes, I think it is. And we need to be careful of what you are implying. Because if -- we are hoping to tighten up many of the things that are loose ends through the 2013 process, and one of those is this thing called air barriers.

MR. STEIN: All right.

MR. WARE: And so we need -- you know, I think we understand what it is that's implied here, but if you're going to use that term for something different than, as you said, like an air barrier used in residential construction as a tie back, then we need to define it some way different.

So, there needs to be some add on to what you think this is that will help us and help our enforcement people in the field.

MR. STEIN: Yeah. Yeah, I mean as I said, I could see enforcement being a bit of a sticky issue. But in my mind, you know, as much as anything it's sort of telling the folks who do the designs what they need to do. So they kind of know if they're going to follow the rules or not. If they want to cheat and get around the rules, you know, it's going to be probably hard to stop them, frankly. But, you know, it's going to be -- I mean this is going to be a great tool for me, frankly, for example, because when I go to my clients I say hey, look, we've got to do air, we've got to do containment. And they say, well, we're not doing it on our last data center, why do we want to bother to do it here, you know?

So this is going to be another tool in my tool belt to basically say hey, look, it's required now, you know, it's been shown to be cost effective, you should be doing it.

MR. SHIRAKH: Mark?

MR. HYDEMAN: Yeah, I'd suggest that we address this with an acceptance test. There's a standard test that's part of the DOE DC Pro toolkit that basically says that you look at the Delta-T across all the air handling units or crawl units rated by the nominal CFM, and then take a couple of measurements across the racks. And you look at the ratio of the Delta-T across the racks to the ratio of the Delta-T across the -- across the crawl units or air handling units and you come up with, essentially, the amount of bypass out of that.

And so we could set a threshold based on that measurement. The measurement protocols are already up on LBNL's website, are in part of the DC Pro tools and we can make it an acceptance test.

And then, you know, either you pass the test or you don't, and if you don't pass the test, you plug some more holes.

MR. SHIRAKH: Jamy?

MR. BACCHUS: Similar to the previous comment from the CEC, is there a requirement for vapor barriers if they're -- if they opt to do humidification?

MR. STEIN: We haven't had anything specifically in that regard, no.

MR. BACCHUS: Worth looking at. It seems that it would be, I don't want to dump all the moisture in the outside spaces if it's -- if they choose, for who knows what reasons, to add ultrasonic humidifiers to try to control the humidity. Not so much the direct evap approach, where they're just trying to reduce cooling energy, but if they actually want to maintain and control humidity levels, then they should be required to put in a vapor barrier around the computer room in that controlled space.

MR. STEIN: I guess I'm not following. If they're adiabatic humidity --

MR. BACCHUS: If they're using any type of humidifiers to control to a humidity level, then they should wrap that space so that the humidity isn't migrating into the adjacent spaces.

MR. STEIN: Uh-huh.

MR. BACCHUS: Then you're just pouring water into the room trying to maintain a set point.

MR. STEIN: Uh-huh.

MR. BACCHUS: So if we're now adding this into the code for this first time.

MR. STEIN: Okay.

MR. BACCHUS: I mean this is good practice whether you're doing a -- you're doing an --

MR. STEIN: Well, when you're saying adding, we're not adding, we're taking stuff out.

MR. BACCHUS: Yeah.

MR. STEIN: I mean people are doing humidity control now with steam humidifiers.

MR. BACCHUS: Sure.

MR. STEIN: So all we're doing is adding a prohibition, it's not like we're adding anything to the code, right.

MR. BACCHUS: But it seems like if we're also saying you can't use extra energy to humidify the space, well, we're going to say that you can't actually dump water in uncontrolled because that moisture's going to migrate through the materials, through the construction materials into the adjacent spaces unless you put in a sealed vapor barrier.

MR. STEIN: Uh-hum.

MR. BACCHUS: The same with an auditorium or any facility where you're putting in water to control a set point for humidity.

MR. STEIN: Are there requirements for an auditorium that say you have to put in a --

MR. BACCHUS: I don't know, I haven't looked at our code in that regard.

MR. STEIN: There's a lot less moisture, even in a humidified data center than in an auditorium.

MR. BACCHUS: But if somebody is stubborn enough that they want to put the moisture in --

MR. STEIN: Uh-huh.

MR. BACCHUS: -- we should put a limit on their potable water use.

MR. STEIN: Okay.

MR. BACCHUS: You could acquire it from some other means --

MR. STEIN: We haven't looked at it, but I guess we could.

MR. SHIRAKH: We need to pick up the pace here a little bit. Matt Tyler is ready online.

MR. STEIN: Okay. Well, these were just examples of containment. This was a seminar, you know, where we were trying to educate folks about, you know, what the requirement means and there's lots of different ways. There's package products that use caps and doors between aisles.

You know, one of the things that we've found is that containment allows you to get rid of the raised floor and just supply into the room. So at Microsoft Data Center there's chimney racks, basically, that can connect to a ceiling plenum so that they just draw from a -- the whole room basically becomes a cold aisle, or a lukewarm aisle.

So the last section I wanted to talk about was the baseline for the ACM manual. Do I have time to cover that or do you want me to --

MR. SHIRAKH: Yeah, go ahead.

MR. STEIN: Okay. So, you know, right now the baseline in Title 24 is a function just of your type, you know, res, nonres, and then the height in stories. And data centers, you know, aren't really defined that way, they don't fit into that category and, you know, the mapping isn't necessarily appropriate for our data centers.

So, we've come up with two new system types that are appropriate for data centers. And the mapping would be if you had a total computer room design load over 250 tons, or if the rest of the building, baseline building, is chill water then you're going to design -- the baseline for the data center will be a new System 6, which would basically be chilled water, computer room air handling units.

If you had a computer room and it is not System 6, then it becomes System 7 by default, which is DX computer room air conditioning units.

If more than 75 percent of the proposed building serves computer rooms, then you're just going to model your whole building as a data center, basically. Otherwise, you have to break out your computer rooms separately and model them as Type 6 or 7.

And the design for those systems are basically what we felt was sort of a reasonable standard of care based on current practice. And so we've come up with a design air side Delta-T to model, two a design return air set point. You know, even the ASHRAE guidelines, which I would argue are too conservative, allows 80 degrees as a supplier temperature, not as a return air temperature. So we're actually saying that the return air temperature is 80 degrees, and then the apply air then would be approximately 60 degrees. So this is a rather conservative baseline, it shouldn't be too hard to beat it.

One fan system per room, typically, you know, your data center will have many, many fan systems in a large data center per room, but we're sort of accumulating them into a single pseudo system for modeling purposes, defining an over-sizing ratio, defining a fan power based on a typical efficiency and total static, not modeling relief fans.

We're going to model an air side economizer, even though it's a chill water data center you could still easily have an air economizer, as opposed to a water economizer.

And the reality is that the software that's available today doesn't really model water economizers. There's a version of the eQuest that's not commercially -- but does a pretty good job.

But, anyway, air economizer modeling is very easily done and is a reasonable baseline.

No humidification, so if you wanted to do direct evap, for example, you would be exceeding the baseline, no re-heat, obviously. And then the plant would just follow the System 4 rules which are already defined for plant chiller efficiency, and chiller sizing, and staging, and so on and so forth.

Some more input on how the baseline is defined, the equipment power density would be input by the user. We're not going to tell you how many watts per square foot your data center is, you tell us.

But we're going to tell you what the load profile is and we're going to use a load profile that cycles monthly between four different loads. So the first month the whole data center's only running at 25 percent load, the next month it jumps to 50, then to 75, then to 100, then back to 25.

And the idea here is that data centers are never fully loaded, even if the operators think it's going to be fully loaded from day one that's, in my experience, rarely the case. They often are loaded up over periods of years. And even if that operator/owner had it fully loaded, the next one might not. And so it's important to capture the part-load efficiency of the design when you're doing the simulation.

And so this captures the part-load at all seasons, basically, as opposed to running, you know, a 25-percent loaded data center for a whole year, and then running it 50 percent for a whole year, we basically sort of captured all that in one annual simulation.

And this is what's being used in the new 90.1 modeling rules for data centers, as well.

We're putting in a lighting power density ventilation and then in terms of controlling the system, when you have a variable volume system for a single zone, you have to have some sort of sequence for how to vary the fan and the compressor, you know, energy tradeoff.

And so the sequence here calls for a minimum fan volume set point of 50 percent. The fan volume linearly reset from 100 percent air flow and 100 percent cooling load to minimum air flow at 50 percent cooling load and below following the infinity laws. And then the supplier temperature reset from the 60-degree design at 50 percent cooling load and above to space temperature at zero percent cooling load.

So what this is, is basically an air flow first sequence. It says as the load goes down the first thing I'm going to do is reduce the air flow. The second thing I'm going to do, once I've reduced my air flow down to 50 percent, is raise my supplier temperature set point from design set point up to as high as the space temperature if the load went to zero.

So it's a -- you know, probably not the most optimal sequence but it's, again, a reasonable baseline. It's one we've used on some of our projects and we've seen out there.

System 7, the DX system, basically for small data centers in it's building that didn't already have a chilled water system, you model it as a DX system.

The assumptions are actually largely very similar, the same air side Delta-T, return temperature, a little bit higher over-sizing because of the discrete sizes of equipment for DX systems for small rooms.

Mapping to a certain minimum efficiency based on the capacity of the system, the same supply fan power, same air side economizer, where prescriptively required.

So, if you happen to have a 4-ton data center in a building that didn't have any economizers, you wouldn't have to have an economizer in this baseline. Again, no humidification, no re-heat.

And these are actually exactly the same as the chilled water, the same load profiles, and the same fan control and temperature control.

So the last thing maybe I wanted to point out here is that the process loads in a data center are going to be defined to include transformers, UPS, PDUs, server fans, power supplies, et cetera. So there was some thought that we could come up with some either prescriptive requirements and/or simulation requirements, baseline requirements that would incent more efficient -- or require more efficient transformers, UPS, you know, electrical side equipment in data centers because there is a quite a bit of energy used by a UPS, or a transformer, for example.

But we couldn’t really come up with a consensus definition of what that would be, you know, what is the minimum efficiency or a methodology to come up with a life cycle cost analysis. So we kind of threw up our hands on that one and just said you know what, it’s going to be a pass through. We’re not going to define some minimum efficiency that’s going to be, you know, giving away rebates or allowing you to trade off unnecessarily. You know, we’re not necessarily going to give you credit for doing better but, you know, it’s all just going to be a pass through at least in this version of the standard.

So, that’s all we had, I think. If there’s anymore questions or comments?

MR. SHIRAKH: Any questions for Jeff in the room? Anybody online?

Just one thing I was going to suggest, you're introducing a lot of new terms for this proposal and so it would be good to have a list of definitions, so we all know like what we mean by rack, or containment, and things like that.

So, and if you can go identify all those new terms and these definitions will probably go in Section 144, not in 101, because they're very specific to this topic, I think that would be helpful.

MR. BACCHUS: Mazier, question to the Energy Commission. Does the illumination or restriction of non-adiabatic or adiabatic type humidifiers cause any heartburn? Should it be stated in a watts or grains-per-pound for a given watt, some other metric, so that you're just saying here's the energy you're able to use, technology neutral to develop your humidification?

MR. STEIN: Yeah, we actually got this one from Washington, they came up with the idea, first, and that's pretty much what they say, the same thing. So at least it flew over there. We'll see how well it flies here.

MR. SHIRAKH: Who are we to argue with Washington.

Gary?

MR. FLAMM: Gary Flamm, staff of the Commission. Two times at the very beginning of your presentation you talk about here's a -- here's a list of process loads and at the end you've got a list of here's a -- here's a list of process or computer room process loads.

What I want to -- that's kind of a mine field. What I've learned in the standards is when you try to be inclusive in a list you often end up with an exclusive list, and that's how it's interpreted.

So I would just warn, whenever you're coming up with a list you need to determine is this list exclusive or inclusive. You understand what I'm saying there?

So when you come up with a process list and the more exhaustive that process list is, the more it's interpreted as being exclusive, instead of inclusive.

MR. STEIN: Right.

MR. FLAMM: And I just wanted to warn that I saw two different lists.

MR. STEIN: So, I'm not sure what you meant by two different lists, can you --

MR. FLAMM: Well, at the very beginning, I think it was your presentation, you said here's a definition of process loads.

MR. STEIN: Well, no, I -- this was already in the standard.

MR. FLAMM: Okay. Well, that's -- the only point I wanted to make is that the more exhaustive a list is, the more exclusive it is interpreted, which may be okay, but you need to go there with your eyes open.

MR. STEIN: Yeah, I -- Mark might want to chime in here, but there was a very similar discussion that was had in the ASHRAE 90.1 deliberations on processes and the consensus there was we wanted it to be an exclusive list, or I can't remember which --

MR. FLAMM: Right. Well, I say inclusive or exclusive --

MR. STEIN: Well, in other words --

MR. FLAMM: Sometimes when you -- when you make a general statement it can be more inclusive, interpreted more inclusive, but when you come up with a list --

MR. STEIN: Right.

MR. FLAMM: -- you can't go beyond that list because the standards interpret that as exclusive.

MR. STEIN: Right.

MR. FLAMM: And that's the only thing.

MR. STEIN: Right, but we wanted that. We actually --

MR. FLAMM: Okay.

MR. STEIN: That's the goal.

MR. FLAMM: Okay.

MR. STEIN: We wanted to say if you had a dry cleaner or something -- actually, dry cleaner's may be covered, but if you had a paint booth or something, it's not covered by the standard, these are the only processes that we are intentionally bringing into the standards.

MR. FLAMM: Okay, yeah.

MR. SHIRAKH: We actually talked, Mark had some suggested language and we decided to go with sort of like this format that's on the screen right now. It's actually named, specifically, the processes that we wanted to regulate and leave everything else alone.

MR. FLAMM: Okay.

MR. SHIRAKH: And the idea was, you know, we didn't want to get into manufacturing processes, and refiners, and so forth. So if you want to regulate laboratories, you mention that, and that's what you're --

MR. FLAMM: Okay. I wasn't aware that the scope -- you know, I wasn't part of that discussion. I just have noticed from my own working with the standards, when I've tried to be exhaustive, I ended up being exclusive instead of inclusive. It's a mistake that I've made in writing standards.

MR. HYDEMAN: So, as Jeff mentioned, we grappled with this in 90.1 when we took out the exception, the blanket exception for commercial manufacturing and industrial processes, and so we had three years of deliberation on that one before we got to dealing with this at Title 24.

I have specific language recommended, it's part of the lab presentation I'm going to do this afternoon. So, if we could hold the discussion off until we actually see the language and how it's crafted, it is crafted so that you're not on the list, you're excluded.

MR. FLAMM: Okay.

MR. HYDEMAN: And that was by design.

MR. FLAMM: Okay, that may be the right answer, I just wasn't sure. Thank you.

MR. SHIRAKH: Okay, I'd like to kind of move on to the next topic, and if you have any questions related to these labs, either let Jeff or myself know your comments.

So, we're going to go back to actually the second item, and Matt Tyler, are you online, can you hear us?

MR. TYLER: Yeah, I'm out there. Can everyone hear me this time?

MR. SHIRAKH: Yes, loud and clear. And so let's get on with process boiler presentation.

MR. TYLER: Okay, why don't you skip ahead to the next slide, please?

So, this proposal includes three measures, all of which are proposed as mandatory requirements for process boilers. And process boilers is a new topic for this code cycle, so I'd like to begin with a few definitions.

The next slide.

So these definitions are proposed to be added to the standards. You can see the last item here, process boiler is simply a boiler serving a process load.

So the next slide.

Section 127(a) is proposed as a brand-new section to the standards, which would be dedicated to process boilers. The first measure that is described here is flue dampers and the proposed language is all listed here, where flue damper or, in other terms, combustion air, positive shutoff should be provided on boilers that are .7 million BTUs per hour and larger.

And let's see, the second measure is fan variable speed drive. This is another mandatory requirement that would apply to combustion air fans of 10 horsepower motors and larger.

The third measure is parallel position control of the fuel supply valve and the combustion air damper. This would apply to process boilers of 5 million BTUs per hour and larger. Essentially this is to -- this is written to prohibit a common gas and combustion air control linkage, which is also known as a single point control or a jack shaft.

So now I'd like to present in detail some additional slides on each of these three measures, starting off with the combustion air positive shutoff. The base case in this analysis, of course, does not have combustion air positive shutoff. The combustion air positive shutoff is estimated to save 30 percent of the total standby loss. Standby losses are two percent of the rated fuel input.

Actually, I think we're skipped down a slide. There we go.

And it also assumes an eight-hour shift times 365 days per year. This includes time in standby and firing modes. And this assumption is quite conservative as we expect most boilers would operate much longer than this to serve process loads.

The fuel cost is $1.22 per therm and this is the present value therm that's averaged over the measured lifetime.

Life cycle cost analysis, payback threshold is just under 12 years, and this is the present work multiplier for the measured lifetime of 15 years, using a discount rate of three percent per year.

In terms of the incremental installed cost, we've got $1,500 that was provided by stakeholders.

In terms of the maintenance cost, on the next slide, we've got $50 controller replacement every ten years and then the following slide shows the summary of the life cycle cost results.

So, crunching through the numbers we can see that this results in a benefit cost ratio of 1.1. This is specific to the minimum-sized boiler that we're covering in the requirements at .7 million BTUs per hour.

And this benefit cost ratios improves as the boiler size increases.

In terms of the second measure, the combustion fan VFD, as far as the assumptions that went into the energy analysis, once again we see 2920 hours per year boiler operation. Once again this is based on an eight-hour shift times 365 days a year. Again, that's a conservative estimate as we expect most boilers would operate much longer than this to serve process loads.

For the electricity cost we've got 16 cents per KWH, and this is a present value KWH cost averaged over the measured lifetime.

So, the next slide is -- this is a figure of a boiler run time histogram, and this simply shows the boiler run times at various firing rates.

So as you can see, the boiler operates at low to mid fire rates for much of the time and this is typical of process boilers, and this is quite favorable for VFD on the combustion air fan.

The next slide shows a list of the incremental installed costs by -- by size for VFD. And, let's see, I'll just point out that the mandatory requirement would apply to 10 horsepower combustion fan motors and larger.

The next slide summarizes the maintenance costs that could be expected, so we're looking at approximately a half-hour per year, or over the 15-year measured lifetime we're looking about $600 for the present value of annual maintenance.

And this slide presents a summary of the life cycle cost analysis. And, in particular, the benefit cost ratio for the ten horsepower motor is 2.7, so you can, you know, see that this is clearly cost effective.

Looking at motors that are larger than this ten horsepower minimum, the benefit cost ratio would continue to improve.

And the final measure here, the third measure, is parallel position control in terms of the energy savings we now assess. We've identified that parallel position control comes standard with low NOx and ultra-low NOx burners through communication with stakeholders and, particularly, a number of air quality control districts around the State, and boiler manufacturers, and boiler sales reps.

Therefore, this particular measure will have the most impact on boilers that do not have low NOx and ultra-low NOx burners.

So our base case is boiler with single point control, also known as jack shaft, without low NOx or ultra-low NOx burner, the major case is similar, but with parallel position control.

One more thing to point out here is that the base case excess oxygen ranges from six and a half percent at high fire to 10 percent at low fire. Whereas the major case would maintain a cost gen excess oxygen across the fire rate and for the proposal it could achieve five percent excess oxygen.

In terms of the energy analysis, we used a conservative estimate of 170 degrees F, difference between the stack temperature and the intake air temperature. Once again, 2,920 hours per year boiler operation, a conservative estimate, and again using $1.22 per therm fuel cost, and just under 12 years for the payback threshold.

In terms of the incremental installed cost, through communication with a number of stakeholders, especially boiler control sales reps, we learned that the total installed incremental cost ranged within a pretty tight bought share $8,000 to $9,000, and that this price really does not vary significantly with boiler capacity, at least within the size range that we're most interested in for the analysis.

In terms of the maintenance cost, there is some additional maintenance cost to this particular measure and this is calculated to have a present value of $4,775 over the course of the 15-year measure horizon.

And in crunching through the numbers we find that the benefit cost ratio is 1.8, so it's favorable for 150-horsepower boiler. And looking at larger boilers than this, the benefit cost ratio continues to improve. So, we're proposing 150-horsepower boiler and larger would be subject to this mandatory requirement.

So, any questions on any of this?

MR. SHIRAKH: I think Jon McHugh has a question.

MR. MC HUGH: Hi, Matt.

MR. TYLER: Hi, Jon.

MR. MC HUGH: I'm looking at the threshold calculation for the -- you know, the 10-horsepower threshold for the VFD requirement on the boiler fan and I was wondering why 10 horsepower, in particular, was selected? You know, potentially, you could go to a smaller fan size -- you right now have a 2.7 benefit cost ratio. You could go to a smaller motor size, potentially those smaller sizes may push you into ECM motors, which have the speed control, the higher efficiency and, you know, the potential benefits of ECM. I don't know if there's issues with availability.

I guess the other issue would be is, you know, at what size you find the boilers are actually modulating versus those that are essentially two-position boilers?

It would seem to me that looking at the characteristics of the boiler firing ranges that that would then present some opportunities that potentially below a certain size a two-speed fan makes sense and above that size VFD makes sense. I was wondering what your thoughts are about that?

MR. TYLER: Yeah, it's true that we could require a smaller motor size for this measure. In fact, a 5 horsepower fan motor and larger turns out to be cost effective. And in terms of availability, through communication with stakeholders, we've learned that a combustion air fan motor with VFD is available down to one and a half horsepower.

But we've been encouraged through -- through our -- or from the stakeholders to implement a mandatory requirement at 10 horse and larger, mostly because this is -- this is a common threshold where their clients are frequently choose to implement a VFD or not.

So, really the proposal is to include this for the first time in Title 24 as a mandatory requirement and potentially revisit it during later code cycles once this becomes even more common practice through this requirement.

MR. MC HUGH: Okay, thank you. In terms of the parallel position control, when we see -- well, I guess some of the similar kinds of questions about the threshold that you'd selected for parallel position control?

MR. TYLER: Yeah, in terms of that, yeah, the cost effectiveness, let's see, that actually makes sense at a lower size in a 150-horsepower boiler. However, this is already quite a small boiler and through additional communication with stakeholders we were encouraged to set the limit at 150 horsepower.

Boilers below that, it is cost effective, but it's just not very commonly implemented yet.

MR. MC HUGH: And, finally, something that actually works in tandem with parallel position controls is a feedback system with an O2 trim sensor. Is there any particular reason that you're not proposing that as part of this proposal?

MR. TYLER: Yeah, we took a good hard look at potentially including O2 trim on top of the electronic parallel positioning and through some field work, and additional communication with stakeholders we learned, both from stakeholders that it's difficult to pay back, and also through our field work we learned that a parallel position system that's tuned well has within the same range of savings that O2 trim could provide at a much lower cost than an O2 trim.

MR. MC HUGH: Thank you. Oh, by the way, for if you went to a smaller size for -- I mean, at what size was this sort of threshold for parallel position controls, just based on the financial evaluation?

MR. TYLER: Let’s see, I’ve got it here and it looks like -- it looks like parallel position control is cost effective for boilers that are 2.8 million BTUs and larger.

MR. MC HUGH: Okay. So, I just have one more comment, which I think it would be useful to take a look at sort of the different thresholds and look at the statewide energy impact, use that as well as the comments from stakeholders to look at sort of the tradeoffs between one threshold versus another. Thanks.

MR. TYLER: Okay, will do.

MR. SHIRAKH: Jeff?

MR. STEIN: Can you hear me? Oh, good. Matt, this is Jeff Stein, with Taylor Engineering. So I guess I have a couple of questions. My first was why are we restricting this to process boilers, I mean why not space-heating boilers?

MR. TYLER: Well, the simple answer is this was -- this was the scope of the project. But, certainly, I would expect that some of these measures could certainly apply to space-heating boilers as well. It’s just a different analysis, especially in terms of the boiler run time histogram and the expected run time at various firing rates.

MR. STEIN: About the low-profile histogram, I didn't catch where that came from. I mean a process boiler obviously isn't going to have any weather dependency, so where did that load profile come from?

MR. TYLER: This was provided to us from Enovity, Incorporated. And Enovity, as you might know, runs a third-party utility program on behalf of PG&E, it's called CIBAP, Commercial and Industrial Boiler Efficiency Program.

And Enovity has access to many boilers that have been involved in their CIBAP program. So, the histogram that I showed is a compilation of a large number of boilers that participated in their program.

MR. STEIN: Okay. I'm also concerned about being technologically restrictive on manufacturers and eliminating a lot of products that might have similar or better performance. I'd like to -- I mean, I'm curious what kind of feedback you had? As I recall, there was a stakeholder meeting or somewhere I remember hearing manufacturers saying that they wouldn't stand for flue damper on their systems it wouldn't -- you know, it wouldn't be safe, it would violating their listing, et cetera, et cetera.

What kind of feedback have you gotten from manufacturers on these different proposals?

MR. TYLER: Well, we went -- we were encouraged to modify the standard language instead of specifying one particular technology, like flue damper, to leave it more open and specify the language as combustion air positive shutoff, which would include technology like flue damper, as well, also leaving it open to other methods to comply.

MR. SHIRAKH: And how does -- it seems like parallel positioning, from my understanding, is also a fairly narrow technology and then there may be other options to meet the similar performance. Could that be described more as a performance requirement rather than a technology requirement?

MR. TYLER: Yeah, it can. And, in fact, that's the way that we phrased the proposed language, so instead of specifying --

MR. STEIN: Can you pull that back up?

MR. TYLER: -- parallel positioning control, the language is based on a performance requirement that the excess oxygen is less and/or equal to five percent. So, it's conceivable that through very good tuning of the boiler maybe that could be achieved. Certainly, this could be achieved through parallel position controls, through O2 trim, and any other developing technologies that could perform such as it's specified here or better.

MR. STEIN: And is here any --

MR. TYLER: Yeah, that proposed language, if you wanted to scroll to that, it's pretty close to the beginning, I think it's the sixth, slide six.

Yeah, there you go. So, this is the proposed language for parallel position control, which is the name of the measure. But in terms of the proposed language, we wrote it in terms of a performance requirement without specifying a particular technology. Although the last sentence is prohibiting certain technology, which is the jack shaft or the single point control.

Which, incidentally, is not expected to meet this performance requirement, anyways, so it's somewhat redundant, but in terms of trying to improve the clarify we wanted to specifically call this out as prohibited.

MR. SHIRAKH: So can we call this something other than parallel position and can define it in terms of its performance requirements? I think that's what Jeff was saying --

MR. TYLER: Yeah, we could. It --

MR. SHIRAKH: -- is that parallel position is fairly narrow.

MR. TYLER: Yeah, so parallel position is the name of the measure, you know, it probably makes sense to rename it at this point based on more aligned with the performance requirement, so we could call it excess oxygen concentration limitation or something like this.

MR. STEIN: How do you see this being enforced? I mean, other than somebody looking for a jack shaft, I'm not sure how it would be enforced?

MR. TYLER: Well, the simplest way is simply to look at how many servo motors are on the boiler and if you have a servo that's dedicated to commanding to a fuel supply valve and a separate servo that's dedicated to serving the air damper, then that's an indication that at least you have -- at least you do not have jack shaft or a single point control.

In terms of -- in terms of proving compliance with the five percent, that's something that -- that a boiler technician would have to show documentation.

MR. STEIN: I mean, I've looked at a lot of condensing boilers lately and they all have variable speed control on the fan and then, you know, a control valve on the gas. So, do those meet the requirement or would they meet the requirement?

MR. TYLER: Yeah, to really prove whether or not you meet this requirement, you'd really need to look at the excess oxygen over the entire firing range of the unit.

MR. STEIN: When you say look at it how would you -- is that through an acceptance test or --

MR. TYLER: Yeah, certainly, this could be achieved through an acceptance test or through -- you know, the simplest would be through documentation that's provided by a boiler tech. And this is a very common maintenance procedure that occurs at least once a year, optimally twice a year on every unit, it's called boiler tuning, as you probably know. And this is when the boiler technician would drive the boiler through its entire firing range, stopping at specific rates of fire and monitoring and recording the combustion products, including monitoring and recording the excess oxygen at various firing ranges.

MR. STEIN: Yeah, one of the things I've learned talking with boiler manufacturers and technicians is that if you tune a boiler too close to the design excess oxygen rate, if you don't have temperature compensation through something like O2 trim control, you're going to have flame failure at low ambient temperature. And so I'm a little concerned that we're going to force people to tune it too close to the optimal and then you're going to end up with flame failure.

I mean one of the things that I've heard from boiler technicians is they don't -- they'll limit the turndown on a boiler, even if a boiler's designed for 10-to-1 or 20-to-1 turndown that they don't want to get the call on the coldest day of the year, when the boiler fails because it was -- didn't have enough, you know, oxygen.

So have you looked at that at all, what might be an unintended consequence?

MR. TYLER: Yeah, we did and we found that three percent excess oxygen was pretty close to the limit of what would be considered optimal per safety concerns. And that's why we added some additional cushion and bumped it up to five percent.

MR. STEIN: Another question was I had done some looking, a couple years ago, on things like parallel positioning and O2 trim control, trying to find some real data on what these things saved. I mean, I'd seen some theoretical data. But have you come across any real monitored data or, you know, had done anything like that? I mean, it seems like a lot of your analysis are based on assumed savings, but I'm -- I hadn't been able, in my research, to come across anything that really shows what they actually saved. You know, and the data I'd gotten was all from manufacturers of the equipment.

MR. TYLER: Yeah, during the literature search for this project we identified a, let's see, a paper in particular that looked at the -- it's ACEEE paper from the University of Dayton.

MR. STEIN: On parallel positioning or --

MR. TYLER: Right, yeah, on parallel position.

MR. STEIN: And I showed savings consistent with what your analyses used?

MR. TYLER: Exactly.

MR. STEIN: Okay. You know, one of the things on variable speed drives, for example, seems like it should be included, is that saving fan energy would increase the gas energy because the combustion fan is providing electric heat. You know, that the energy consumed by the fan actually is manifested in heat that goes into the combustion air. I don't know if that was part of the analysis or factored in at all?

MR. TYLER: Yeah, you know, unlike -- unlike hot water, unlike a hot water measure where VFD may not be as favorable, you know, we've got process boilers that are operating over the entire course of the year and so unlike VFD on a pump, for a heating boiler, the fuel rate is not -- is not so dependent on peak periods. This is a gas rate that is more constant over the course of a year, so it is cost effective.

MR. SHIRAKH: And I can see that Jeff's got some concerns about this and I want to encourage the two of you to kind of pick up offline, if you can have this conversation.

MR. STEIN: Okay. I guess one more quick question, if I could. Did I hear you say that these were mandatory requirements or are these going to be prescriptive requirements?

MR. TYLER: Yeah, this is proposed as mandatory requirements and part of that -- part of that is that there's no -- there's no way to compare -- there's no way to use the compliance software to look at these particular measures and compare it against some prescriptive baseline.

MR. STEIN: Okay. I mean -- all right, well, maybe we better take it offline, then.

MR. SHIRAKH: Yeah. I mean, these are important questions, but just for the sake of time I think we need to take this offline.

Jon, one quick question?

MR. MC HUGH: Yeah, just one quick question. Matt, for the Enovity data that you had on load profiles, et cetera, what did you find was sort of the average number of hours, the 25^{th} percentile number of hours, that kind of thing? I mean it seems like one eight-hour shift -- when you start looking at larger boilers, they rarely run one eight-hour shift and I was wondering what you'd found from that survey?

MR. TYLER: Yeah, I don't have a specific number of hours off the top of my head right now but, you know, certainly it's higher than 2,920 hours per year that we used in the analysis. We just wanted to present a conservative case here and but, yeah, it's longer than an eight-hour shift, 365 days a year.

MR. MC HUGH: Yeah, it would be just worthwhile to find out what that is so you can see just how conservative you are. Thanks.

MR. SHIRAKH: In terms of just other comments related to applying some of these measures to space heating boilers and, you know, I think that's a good idea, I just don't know do we have the time for -- what kind of analysis do we need, what kind of justification do we need for that? It seems like, you know, we shouldn't miss that opportunity if these are slam dunk. And I don't know if, Matt, you're the right person to do that or is it --

MR. TYLER: Well, the biggest change is that the analysis would need to be climate dependant, whereas now the analysis is based on process loads, based on loads that are heavily dominated by process loads rather than climate.

MR. SHIRAKH: So it sounds like this is an entirely new project and Pat Eilert's here in the audience, I don't know, we should probably have a discussion about this, if there's something we can support here.

MR. BACCHUS: Matt, looking at the environmental impacts and the non-energy benefits in the case report, I don't know if it's a mistake, but it's listed that there are no environmental benefits.

MR. TYLER: Yeah, I need to update that report and reissue a revised copy.

MR. BACCHUS: In the -- in the air quality summary there are no units on the NOx and Sox. But if those are all avoided emissions, then I would say that those are benefits. Is that an oversight?

MR. TYLER: Yeah, you're correct, it's -- it is avoided emissions.

MR. SHIRAKH: Thank you. Mike?

MR. MC GARAGHAN: Mike McGaraghan, Energy Solutions. I just wanted to ask Jeff -- Jeff, it sounded like you had some concerns about the measure, but you were also the one that suggested that you thought it could be a good idea for space-heating boilers, or you were just curious?

MR. STEIN: Yeah. No, I just wanted to know what it was about process that made these applicable and didn't make it applicable to space.

MR. MC GARAGHAN: So, from your perspective, you're not proposing that you think that would be in?

MR. STEIN: I would need to know more. I haven't dug into this one, I haven't read the whole report or seen the comments from the manufacturers, so I wouldn't be able to say.

MR. SHIRAKH: So, it sounds like we need to have a discussion offline with Jeff, and Matt, and us to work through this process and then decide if this is something we want to expand to space-heating boilers from that point on.

Any comments from online?

Okay, so it's 12:35, why don't we meet back here at 1:20, that gives us 45 minutes for lunch.

And the afternoon topics have to do with indoor air qualities, IAQ, and so we'll start at 1:20. Thank you.

(Off the record at 12:37 p.m.)

(Back on the record at 1:20 p.m.)

MR. SHIRAKH: So again, this is the afternoon session of the April 11th, 2011 staff workshop. We have three topics we're going to present for this afternoon. The first one is the laboratory exhaust, and Mark Hydeman's going to present that one.

The second one is going to be the commercial kitchen ventilation.

And the last one's going to be the garage CO sensors and Jeff Stein will present both of those.

So, I think we should go ahead and get started.

MR. HYDEMAN: Thanks. Mazier, do I need to do anything to share the screen or is it already sharing the desktop, it kind of indicates on there.

MR. SHIRAKH: The people who are online, can you see the screen, if there's anyone there?

MR. HYDEMAN: Okay, this is Mark Hydeman speaking.

We've got two measures that we'll talk about this afternoon, the first one is VAV supply and exhaust at the zone level, and the second one is energy recovery, and we've limited that to run-around coils for the analysis, for reasons which I'll discuss.

The first part of this is a overarching section of how we're intending to cover process in Title 24, 2013 and forward, and this is a recommendation that we've already discussed with the Commission and kind of everybody's agreed to the format.

I wanted to present the details at least in one of these reports so that we had them someplace, at where everyone could review them and comment on them.

So, in Section 101 of the definitions we're adding -- proposing to add a new definition for covered process and covered process load.

The existing standard already has a process/end process load, as you can see in the next bullet item, 5.1.2. And we're suggesting that we create two types of processes. One is a covered process and that's one that is explicitly identified as a process that is now covered by portions of the standard, and then everything else falls under exempt process.

So, the definition of a covered process includes the following items; datacom equipment, laboratory exhaust systems, garage exhaust, kitchen ventilation and refrigerated warehouses. And I realize I've got datacom equipment, but it's really the systems serving datacom equipment, laboratory exhaust, garage exhaust, kitchen ventilation and refrigerated warehouses.

And a covered process load is a load resulting from a covered process.

We'll then take the process definition that already exists and we'll call it exempt processes. And an exempt process is defined as a process that previous was, with the caveat that it is also not listed as a covered process. So, everything else falls into an exempt process, if it's not listed under covered.

And then exempt process load is the result of an exempt process.

So from here on forward we'll be using the terms exempt process and covered process in the standard.

In section 121, which is minimum required quantities of outside air, you have the table 121.a, which is the minimum building borne contaminants. Actually, everything goes to Section 121.b.1 or 2. 121.b.1 is the requirements that go to table 121.a, which are the building borne contaminants or the 15 CFM per person, with the assumptions of the number of people as expressed in that section, or required makeup air for exhaust systems that are required for an exempt process or for a covered process.

So, we're allowing for the increase in ventilation for a process, whether it's exempt or covered. So, there's really no change in stringency in Section 121.e.

514 says modify exceptions to Section 122.b as followed, and this is the zone thermostatic controls. We're only allowing this exception to cover exempt processes, and if we want to add some relaxation over the zone thermostatic controls for covered processes, they'll have to be addressed in separate exceptions.

123, it's interesting that the piping serving process loads was previously exempted. Process loads typically run much longer than non-process loads and, therefore, the effectiveness, the cost effectiveness of putting insulation on things like heating piping or cooling piping would be, in fact, even more cost effective and more strenuous requirements would be cost effective for process environments, things like data centers, or labs, or others.

I think that this was in there from -- I have no idea of what the thought was that all piping load process was accepted in the past but, anyway, it seems to me that if we want certain processes to be accepted we should list those, as opposed to having a blanket exception.

Calculation of budget energy use, it's really critical under Section 121.c, which is the performance method that we allow for exempt process loads to be covered so that we have a tradeoff method. So, many of the things that I'll be talking about, specifically for labs, is what Jeff spoke about earlier for data centers, and what I'll be talking about for kitchen exhaust and garage exhaust will want a performance method that can be used to trade off the energy of the various things that we're putting in the prescriptive sections.

144.c, I've got a note here I want to add fan power limit and exception for lab exhaust components from 90.1. That was not included in the copy of the case write-up that was on the website. I have included in these slides, which I've updated in the next two slides.

So, any fan power causes solely by an exempt process load can be taken out. And on the following slide here, this is straight out of 90.1, are the pressure adjustments that 90.1 added specifically for data centers -- or sorry, for laboratories. You can see things like exhaust systems serving hoods, laboratory and vivarium exhaust systems in high-rise buildings. There's a number of things in your cooling run-around loop, and others, that were added as a part of this working group of 90.1 and the Laboratory Technical Committee.

So, we're going to propose that we give the same credits or similar credits in Title 24 to what 90.1 is providing for fan power.

Section 144.d, this is the reheat, recool minimums for zone controls. And, again, we're just making the distinction that between the exempt processes and covered processes. So, covered processes, as we talked about with data centers earlier, we don't want to give them blanket exception for humidification because it uses an awful lot of energy. And so covered processes, if they need to have an exception from this section will have to have that crafted for each of the processes that are being covered.

Modify exception to Section 144.e.1, this is economizers. And we're recommending the strikeout of exception four to 144.e, which exempted data centers, and we're again changing the word process in the other sections to exempt process loads.

144.f, exception three to 144.f, this is fly temperature reset. Again, this has to do with humidity levels and, again, we're applying it only to exempt process loads.

Okay. So, our proposed changes are to add a new requirement in 144 as follows: buildings with laboratory exhaust systems where the minimum circulation rates to comply with code or accreditation standards is less than ten air changes or less than the exhaust -- the design exhaust flow should be capable, basically, of requiring a VAV.

And we will add an exception under this that the hoods can remain constant volume where required by code, the authority having jurisdiction, or the facility EH&S department guidelines.

And then under the ACM we will have a new laboratory HVAC system, it will be a variable air volume, air handling unit with 100 percent outside air, with pre-heat coil and cooling coil, and constant volume will be modeling as a plug load in unconditioned space equaled to the scheduled motor horse power of the exhaust fans.

And VAV zone controls with air flow minimums to match those mandated by the HJ for each lab space occupancy. So, it will be by a schedule.

The section on heat recovery, we're suggesting to by that in the "reach" code for now. As you'll see in a little bit, the life cycle cost analysis has not been great for it and there's still some concerns out there by a number of the stakeholders about putting coils into exhaust streams.

This hasn't changed from our previous presentations on the proposal and that is we're defining typical practices, spaces ranging between six to 12 air changes for ventilation minimum. Hundred percent outside air constant volume reheat systems. A 3,000 feet per minute exhaust at the stack. Between four to six inches pressure on supply and exhaust fans.

We're assuming that the base case will have supply air temperature reset, it seems most facilities are doing that anyway, voluntarily, because it's a great energy measure, particular where they have DDC to the zone.

And constant volume fume hoods.

VAV fuel exhaust systems or standard off cell technologies, they save fan energy primarily on the supply, but they can also reduce the amount of air on the exhaust because you can take a diversification on the exhaust and have a smaller design exhaust air stream than some of the peak demands of the zones.

They reduce reheat heating and cooling energy. They have been found in the field and verified through some studies that we've done, pre- and post-retrofit studies of occupants that they have, in fact, improved the comfort.

They make systems safer during remodels and retrofits. A variable air volume system has dynamic valves installed in it that are pressure independent, so that if someone is working either on the exhaust system or the supply system and they're adding, or removing, or retrofitting, or rebalancing a room, it's actually impacting on a constant volume system all of the other zones that are attached to that duct work.

In a variable air volume system all the other zones react and control directly to the program CFM. And some hoods will remain constant volume.

The costs that we're using for the purpose of this came from actual retrofit costs. You'll notice down at the bottom of this we have some case study materials that we got from Labs 21. They're numbers were around $4.2 per CFM on average between the various case studies that we saw reported.

We're using, conservatively, a number of $14 per CFM, which came from retrofits. And, obviously, retrofits have higher costs than new construction, and so all of our analysis is based on this conservative number of $14 per CFM.

Simulation results were -- used a calibrated O2 model based on an actual lab building at Stanford. It was calibrated to the several years worth of electrical, chilled water and metered hot water data for the building. And we varied, in the modeling, the minimum air change rate for each of the zones to show the relationship between the ceiling -- or, sorry, the floor of a certain air change rate and the potential savings of going VAV.

Obviously, if you increase the minimum air change rate or the floor, then your savings decrease because there's less of a variation on air flow.

Okay. The graphically results for the climate zones that we looked at, this is eight of the 16 climate zones. These eight zones represent over 85 percent of the construction in the Dodge database, starting in 2013. The way to read this is that a positive number means that it's not cost effective, it's increased the present value. So, you've paid more, $14 per CFM, to put these lab controls in and the energy savings failed to offset the first cost premium.

So you can see in all cases, except for the 14 air change case in climate zone 13, in all cases, even with a 14 air change floor, VAV retrofits were cost effective.

Here's the same thing in tabular results, showing the six air change and the 14 air change rate and, again, you'll see that it was cost effective everywhere, with one exception, and that's this one here, 14 air change -- changes, and the present value is positive, not negative. So it was an increasing cost, not a savings, using the TDVs for 2013.

We've had a number of stakeholder meetings and there were some concerns expressed about lab exhaust. One of them dealt with the speed of response, I'll show you on the next slide. And all of the responses that we got from the industry were using the ASHRAE 110 test methods.

Feedback on system failures, we plan to add requirements to have a audible or visible alarm both on low-face velocity and also on room air balance. And we're open to some verbiage on how to achieve those, but it is our intent to add that.

Commissioning, we plan to actually add an acceptance test that will have everyone test each room and all hoods to make sure that they're operating properly.

So, there's some feedback that we received from TSI, Siemens, and Phoenix, three of the major manufacturers of these systems, and this is all part of the record now, but it just shows the speed of response that they've seen on their systems.

This is Phoenix and, finally, Siemens, which is an actual field test result.

So the next set of stakeholder concerns, I just received an e-mail from the last workshop that we had, that they would like the standard to include the following statement, which is all laboratory hoods must be designed, constructed, maintained, and operated in accordance with Title 8, California Code of Regulations, and then specific sections.

And we're spending a little bit of time going through these codes, and we need to go through them with stakeholders as well. But it occurs to us that it may make more sense, rather than doing this, to do what's been in 90.1. And if you look in the scope section of 90.1, it clearly has a statement that this standard shall not used to circumvent any safety, health or environmental requirements. Codes are codes and you obviously have to comply with all the codes listed on a building, when you're building it.

And so whether or not we say this shall comply with Title 8 and these section, you do in fact have to comply with all of the codes.

My concern with listing specific codes is it's, as was discussed this morning, if you just list some does that mean all the others don't apply anymore? And so it's going to become a maintenance issue and it may add confusion by specifically listing certain codes and not listing others.

I think if we had a broader statement like this, at the very front of the standard, and I need to talk with Mazier and other CEC staff about where we would put that, that that's a much broader statement that will apply not only in this specific case, but in all cases. And not only in the base standard -- sorry, in the new stuff that we're doing for processes, but also in the base standard.

I could not find it, Martha, I don't know if you know of any place where something similar to this is stated currently in the code? I couldn't find anything. Okay.

Some of the non-energy benefits of VAV safety, all valves are pressure independent, I mentioned this early. Systems measure air flows and are able to report on low hood velocity and loss of room pressure. And, again, we're going to require some testing on that and we'll also require some alarming.

Acoustics, we've done a number of retrofits where pre- and post-measurements were done by Charles Salter Associates. And they found that, in fact, by going VAV the acoustical environment of the labs got much better.

You know, in one case it was interesting, somebody complained that it was noisier after the retrofit and they went and took sound power measurements, it was actually not noisier, they could finally hear the air pump that was sitting under a desk that was masked by all of the diffuser noise in the past. The sound power measurements had gone down significantly in that lab.

Comfort, you get reductions of draft due to lower air flow. And air flow across hood faces is a big problem and has been shown in the field to cause retrainment of fumes. So, by reducing the amount of air flow when the lab is not under a large load, you have many more hours where you have lower draft across the hood, so that's also a safety benefit, as well as a comfort benefit.

And maintenance VAV operation reduces wear on motors, belts and bearings.

So, the next step for VAV, we'll make the changes to the report as noted on the slides. The fan power per section in 144.c, per 90.1, and I included that table previously in these slides. And we'll add an exception to the new 144 requirement for VAV allowing constant volume exhaust where required by code authority having the jurisdiction or the facility HNS department.

Obviously, we also have to add the acceptance tests.

So, I'll move on to heat recovery and then we'll take questions. Estimated cost heat recovery, we looked at two types of run-around coils. The reason we looked at run-around coils is that they can be provided spatially distant from one another. Most labs, if you look at them, have the air handling units bringing air in generally on the lower floors, and certainly on the sides of the building, and the exhaust is up at the roof of the building.

And there's this spatial separation that's often many hundreds of feet between where the exhaust is going out and where the outside air is coming in. Although in theory you could use things like desiccant heat wheels, or dry heat wheels, or air-to-air heat exchangers and you would get much higher effectiveness, using a run-around coil is always possible even if the exhaust and outside air are separated.

So we looked at two different designs for run-around coils. One was a relatively low heat transfer effectiveness, about 30 percent, and another one was what was considered a high effectiveness, around 50 percent. We priced them out on the same model building that we were working on and we came up with a cost, as you can see down here, for low and high effectiveness, the 50 percent and the 30 percent.

We ran four climates, climate zones three, eight and 12, two efficiencies, both constant volume and variable volume because these are separate measures, so if the variable volume measure fails or if we have exceptions for all constant volume systems, we wanted to be able to look at that.

And then we looked at it at two minimum air change rates, 10 and 18.

What you see here is the results on those four climates, with the two effectivenesses, and the constant volume VAV case, and at the very top we have the air change. And it's based on the Title 24 part six TDVs, and down here it's based on the "reach" code TDVs.

Those items that are in red are not cost effective, those items that are in black again are negative, are cost effective.

And what you see is in climate zones three and eight, the more mild climate zones, the increased fan energy by introducing these coils, both on the supply and the exhaust side, basically more than offset the energy savings of the boiler that was making hot water to do the reheat. So, run-around coils, actually in defiance of conventional wisdom and recommendations from Labs 21 and others, appear not to be cost effective in a lot of climates, if you actually take the time to model all the fan energy, and the pump energy, and everything else.

So, there are elements that increase energy use, and it's all electrical energy use, and you're often just offsetting gas usage. So, the scalers are very different.

In climate zone 9 and in climate zone 12 we certainly were cost effective in almost all of climate zone 12. And where you've got a VAV system, where you're not taking that fan energy penalty all the time in climate zone nine.

The "reach" code was not much different, almost the same in every category, just slightly higher payback.

This is the same results presented slightly differently, this is energy recovery. This is 15-year life cycle costs climate zone three, climate zone nine, climate zone eight, climate zone 12. The red in each case is the low effectiveness, the green is high effectiveness.

And if it's negative, it's cost effective, and if it's positive it means, again, you have a higher present value than you did if you didn't do this measure.

It helps to see it in the energy results, this is the energy only. In this case the energy below the bar, which is all the fan energy, is a savings, the energy above the bar is -- sorry, this is an increase in energy. Not a savings, it's an increase in energy. And the stuff above the bar is all the savings that you have.

And you can see in this case that you increase fan energy much more than you've saved energy costs by reducing cooling, heating, and other things.

And then the net of the two is shown here.

MR. SHIRAKH: I notice you have a question. Can we -- do you want to -- we'd like to hold the questions until the presentation is --

MR. HYDEMAN: Yeah, I'm just about finished her, Mazier, so if we could.

So, stakeholder concerns, we also have strong reservations about heat recovery systems that rely on coils or other impediments to free air flow being placed within existing ducting. And this has been a concern that we stated as well in these sessions, that one issue with having a run-around coil on the exhaust side is if there's anything that collects on that coil it's going to be very hard to clean the coil, you'd have to shut the system down. And we have not included costs for, for instance, bypassing the coil so that you have like a damper system where you can go around the coil, and open the coil section up and isolate it, and clean it.

So, at least one of the stakeholders, who's associated with one of the State health agencies sent this to us. So, I think it's something that we need to look at and we'd like to get some more feedback on how it's being done in the field.

Okay. Heat recovery, we'll run this in more climates and we're going to consider it for the "reach" code, which means we're going to table it for the time being and try and receive some more feedback on it. But we're not considering it anymore for the base code.

Okay. There we go, Mazier, I'll take questions now.

MR. SHIRAKH: Okay, now it's time for questions. Anybody in the room? Please identify yourself.

MR. BACCHUS: Jamy Bacchus, NRDC. Mark, some of the air change rates between the different measures were varied, you had six, ten, 14 on the variable flow, and then you had ten, 18, and something other. Is there a reason for the difference?

MR. HYDEMAN: Yeah, how do I say this politely? Yes, and it was due to poor instructions on my part.

But I think we have enough data there to have a good sense of where things break. So it's quite common, as I said, to see that most facilities are around six air changes and some facilities have higher air change rates that they maintain for a number of reasons, the 10, 12, 14 are not unheard of, and air change rates up at 18 are higher than anything I've seen as kind of a base air change rate for indoor air quality.

But you may have labs that are designed at 18 or 24, even, because of the loads that are there, constant volume systems. But, no, there is no reason for the disconnection.

MR. SHIRAKH: Okay, any other questions for -- Deborah?

MS. GOLD: Deborah Gold, CalOSHA. I have a question, how was it decided that these specific processes were going to be considered to be covered?

MR. HYDEMAN: Deborah, in answer to the question, these were the measures that were proposed as part of the Case Initiative, so the utilities came out and said we have some money, we would like to help enhance the efficiency of buildings in California, bring us your ideas, and then they winnowed them down through a -- I don't actually know what the selection process was, but they had a sense from their own utility programs and what incentives they've been paying which were the -- the most likely measures to succeed and deliver energy savings and they were selected.

So, the ones that are listed there are ones that are active Case Initiatives.

MS. GOLD: So, what I want to understand is what -- the purpose, as I understood it, for exempting processes was to recognize that there are other reasons for using energy than just thermal and occupant comfort, and so certain things were called processes. And were, therefore, if we were going to include them in the Energy Code, special attention had to be paid.

And now what we have is a complete kicking out of certain processes that happen to affect employees more than probably anybody else. And I'm interested in how these particular processes were selected to be kicked out of that harbor that recognizes that there are other purposes for ventilation that need to be addressed.

Now, am I wrong about that?

MR. HYDEMAN: Well, I would -- I wouldn't say you're wrong about it. I'd say there's many different reasons that processes had a blanket exemption. And we had the same thing in Title -- in 90.1 until the 2010 standard, and we spent three years going through the reasons to include or exclude processes.

One was the lack of expertise, right, so if you don't have expertise in an area, you don't want to go meddle in it. We know nothing about -- as a group, sitting around the table, the engineers, the CEC staff, and others, trying to regulate things like smelting, right, we know very little about that. We don't have cost date for the smelting processes, on and on.

There's certain things that you just want to exclude because you don't know enough about them and you know that there's some health and safety concerns.

Those that are included are areas where there was expertise around the table, and within the community at large, they're people like the manufacturers I previously mentioned, TSI, Siemens, others that are participating in this, where we could say, okay, labs, we have enough expertise, let's put together a case proposal, let's bring it back to the industry, get industry feedback and put it in that covered category.

The same thing is true about supermarket refrigeration. Evo.com Technology, and others, have expertise now and it's practiced field experience in doing energy efficiency measures. The utilities have experienced, Pat can speak to that, and others, and they've been paying incentives on variable air volume conversions on labs and on best practices for supermarket refrigeration and others.

So, they've gone from a non-covered to a covered due to that body of experience.

MS. GOLD: Okay. Well, my experience is with this process is I wouldn't be overwhelmed by the amount of knowledge, nor the inclusion of all the stakeholders who need to be included in this. And I would suggest just as a general approach that rather than having, calling these processes covered processes that we should at least say they're conditionally covered, or something like that to recognize the fact that there are hazards. Particularly in laboratories, where we're handling some of the most dangerous substances, and where we're handling dangerous pathogens, where it may not be sufficient to pay only attention to energy and we need to recognize that a lab hood is not a lab hood is not a lab hood, and that there are places where what's being covered is specifically dangerous and you can't rely simply on the facilities, nor anything else, to adequately address these.

And I mean, what I have to say about lab hoods is that CalOSHA has for ten -- no, more than ten years, 12, 15 years we've been working on this issue of how to save energy in lab hoods without damaging the health of people who work in their vicinity.

And I would say this about all the other of these processes that are included here, with the possible exception of datacom, just because computer equipment has changed a lot in terms of the thermal loads at places.

But in terms of all of these things that if you are going to cover them that we should use a term like conditionally covered process, or something like that, to make it clear that when we're going to address them in the Energy Code that we're going to be paying particular attention to these hazards that are associated with processes and not just include them. So, that was just a comment.

MR. SHIRAKH: Can I ask you --

MS. GOLD: Are asking only questions or is this where we're giving comments on things?

MR. SHIRAKH: Well, and I just wanted to add a little bit. I mean, the Commission has always had the authority to regulate process loads --

MS. GOLD: Correct.

MR. SHIRAKH: -- we just chose not to do it for the reasons that Mark mentioned. You know, but we also have this mandate to move towards zero net energy and we have to look at, you know, places where energy savings are possible. And, you know, I hear your comment about impact on the workers and the occupants, and that's where we've had this, at least three rounds of stakeholder meetings that we presented this information to you and others, just to make sure that, you know, we are not jeopardizing the workers' safety.

And whether you call it conditional process covered or just covered process, what the details that goes into each section would ensure that, you know, that the occupants or the workers are not -- are not hurt by this, and that's why we've been working with you.

MS. GOLD: Well, we have been working, but I have to say that most of -- many of the things that we've suggested haven't been incorporated or remain nebulous. So, those are some of our concerns and we recognized that UPTE wasn't among the people who you've consulted, the Union of Professional and Technical Employees, or AFSME, or any of the other people who work with lab hoods.

You know, CalOSHA can attempt to represent some of these interests, but when you talk about, oh, we talked to all the stakeholders and it turned out that everybody was in the room. Well, they're not and somehow we need to address that issue.

MR. HYDEMAN: Deborah, can I please respond to these? Because I think we have tried to reach out and respond to your comments. And we also sent to you, well in advance, the schedules of these meetings and ask you, as well, if you knew of people that weren't brought to the table --

MS. GOLD: But let's not go back over the schedule of these meetings and the meeting that we weren't notified of, that's not appropriate.

MR. HYDEMAN: If you knew people that needed to be brought into the process, we encourage you to forward either their contact information to us or to forward the meeting announcements. And we did this at every one of the meetings, we said --

MS. GOLD: No, that's true.

MR. HYDEMAN: -- we need -- we said we need expertise brought to the table.

MR. SHIRAKH: Okay, we're not going to --

MS. GOLD: I don't want to go back and forth with you, that certainly wasn't true.

MR. SHIRAKH: Both of you, we're not going to argue about that.

Do you have any specific comments about this?

MS. GOLD: I do have some specific comments.

MR. SHIRAKH: Okay.

MS. GOLD: One of them I just made, which was rather than excluding them as a quote, covered process, from extra consideration, that you set up another category that would be conditionally covered processes so that we draw attention to the fact that these processes require specific attention before making modifications, and instead of just calling them covered processes and moving on. So, that's one of my suggestions.

Another thing that I want to point out is that you're exempting in terms of humidity, you should be exempting biological laboratories. Biological laboratories that are attempting to maintain delicate pathogens often need specific climate control in those labs and that should be addressed in this section, otherwise you're going to kill off the bugs.

I also want to say that we strongly support, we sent the language referring to Title 8 which, by the way, did used to be and may still be in the Building Code regarding ventilation systems, where there was a specific reference made to Section 5143. We believe that it's fine that you can craft language that says that all codes have to be followed, including these sections, but we think it's important to draw designers' attention to the fact that there are other codes that are requiring specific face velocities, specific duct velocities, and then have other performance requirements which, if they are not met by all the engineering and stuff, are going to result in exposure to carcinogens, and reproductive hazards, and possible flammability issues.

I'm also curious because you made a kind of a blanket statement that high air flows cause reentrainment with hoods. I think that depends on exactly what air flows we're talking about. There are always issues of turbulence at the entrance to hoods, but they're also -- hoods are designed to deal with that turbulence.

If what you're talking about is reducing cross-flow at the hood fact, that's certainly important but may -- but that has to do with directionality of the air flow and how air is provided into the lab or how suppliers provide it into the laboratory and then how the air flow -- how the hood is designed relative to that, so that you're maximizing hood capture and minimizing cross-drafts.

And I think those issues need to be addressed, the issue of how air is introduced into the laboratory needs to be addressed in whatever, the ACM, or whatever else you're going to put it into because that's going to be critical. If you position the lab hood in the wrong place, versus the supply hood, then you can -- versus the supplier, then you certainly are going to have an ineffective laboratory hood.

MR. HYDEMAN: To that point, a constant volume system and a variable volume system have exactly the same challenges.

MS. GOLD: That's absolutely true.

MR. HYDEMAN: We're not introducing anything by going from constant volume to variable volume. And my point about the experience that we've had in the field is that the problem with constant volume systems is that they're always blowing the same amount of air, which is the most extreme condition of that system, and that is the highest velocity at all times, wherever that diffuser is in relation to the hood, it drops the hood so --

MS. GOLD: But if you -- that may in fact be true -- it is different to design for VAV and for constant volume. But what I'm saying is if I've set up my laboratory with the idea that there is a constant flow that's going this way, and now I'm cutting back that supply flow and I still have room air currents, and I still have currents caused by people's movement, you're going to affect how that hood is operating in that room.

So, if it's a well-designed hood, with a constant volume supply to the room, then you -- then, presumably, if you've accounted for that -- if it's a badly designed in any system, it's a problem.

With VAV you add in the fact that you have to model the air flow in the laboratory based both on the low volume, and the higher volumes, and count into it then people movement, equipment movement, and other things that really do affect whether the hood successfully captures. And I'm kind of interested that you put in this study by Siemens, who said, yeah, we started to test this thing out and then it turned out that the hood was obstructed. So then we took the obstruction out and now the hood was working fine.

Well, I hate to tell you this, but in doing inspections in laboratories, hoods are very frequently obstructed, sometimes they're completely obstructed, and that affects their efficiency.

So it doesn't prove to me that you've solved the problem if you've failed the test when the lab was used as it was normally used, and then you remove big obstructions and then the test worked. To me, that's not proof that this is a satisfactory system.

So, I realize that you -- that the Energy Commission, and building codes in general take no responsibility for what happens after the acceptance test is past, but we need to look at how these things are used, how these things are used in practice, and whether these things are going to function.

So I just found it interesting that this story about Siemens, we said, yeah, well, we found -- but then we found on the right side these three-gallon plastic bottles, so then we took it out, and meanwhile the smoke escaped from the hood. But the fact is that's how hoods are used.

And when you talk about reducing air flows and not maintaining, and reducing all of the -- and changing the ventilation systems, you need to account for the fact that hoods are not always used properly.

MR. HYDEMAN: Right. But the same issues occur whether it's contact volume or variable volume.

MS. GOLD: That may be true.

MR. HYDEMAN: You're maintaining -- you're dynamically, at least, with a variable volume system you're maintaining the desired face velocity across the opening.

MS. GOLD: Well, you're maintaining it when the delay time -- when the system has reacted. And I know you gave an idea reaction item of seconds but, again --

MR. HYDEMAN: Well, we gave you what the manufacturers gave us.

MS. GOLD: Well, I know that. But you know what, sometimes things bear further investigation. And when the manufacturers say this is a whiz/bang hood and it responds like that, that doesn't necessarily mean that it does respond like that, and air currents don't change like that. So, you know, I think that this requires -- I think if you're going to make changes and, more importantly, if you're going to mandate changes as compared to allow changes, that when you mandate changes you have to take responsibility for what is actually going to happen in the field and whether things really do change that fast. Because they don't and when we're working with carcinogens, and we're working with substances of high acute toxicity, the fact that it changes that fast may be a problem.

MR. HYDEMAN: Okay. I would point out that the Technical Committee from ASHRAE, that's responsible for laboratory design, worked together with 90.1, and on 90.1

the base code of all energy codes in the United States, including California, it's a base that DOE uses for determining state compliance with federal laws on energy efficiency, includes provisions for variable air volume. So this is not something that we're -- we're not on the bleeding edge here.

MS. GOLD: Well, you know, I don't want to argue with that. We've had this argument about ASHRAE before and the bases of some of their decisions in any number of other contexts, some of which is just back-of-the-envelope hand shaking.

But what I have to say is that you are about to mandate something in California and you have a responsibility to take a responsible look at it and not just say these other guys say it's okay. And that's what I'm asking for, that's what we've been asking for in CalOSHA throughout this whole process is the actual data is the actual tests. So what we got were a few anecdotal stories, one of which I think doesn't prove the point at all. You know, and I think there's a responsibility, as somebody who's going to mandate something, that you show not just that ASHRAE recommends it, but that it's going to function. And that it's going to function five years, ten years, 15 years out because that's where we find them. That's where we find them.

MR. HYDEMAN: Thank you.

MS. GOLD: Let me make this clear, we think it's fine to put something in the beginning of the code that says that this doesn't preempt any other code, and we think it's fine to say this code should be used to rule out Health and Safety Regulations Code. And in case I wasn't very clear about this, we believe it's important to have the specific Title 8 references to these laboratory hoods so that people design with the intention of complying with those standards.

MR. SHIRAKH: Okay. And what would be the implication of making reference to Title 8, Mark?

MR. HYDEMAN: I will be glad to look at it. I'd like to also have the Title 8 provisions sent out to all of the stakeholders to review and comment on.

MR. SHIRAKH: Okay. Any other questions related to the labs? Anybody online?

Okay. Well, Jon?

MR. MC HUGH: Jon McHugh, with McHugh Energy. And just like to just talk a little bit about, you know, why we looked at process loads in particular. You know, we've actually done quite a bit over the, you know, last 40 years in terms of -- or 35 years, in terms of having a building efficiency standard in California and we've sort of exhausted many of the sort of the low-hanging fruit, so to speak, for many of the other building components.

And process loads are significant. And I think Mark has covered a lot of this already, but in many spaces there are repeatable process loads that can be address, you know, that are not specific to a particular activity.

And just as an example, for the University of California system their energy manager, you know, had put together an evaluation of the energy consumption of different UC buildings. And one of the key determinants of higher energy consumption was, of course, the presence of a lab in that building.

So, that there was a huge opportunity associated with labs became fairly evident. And at the first part of this meeting we've talked about other process loads, so process boilers, compressed air systems, and we kind of started this process looking at loads that are beyond just comfort and space conditioning when we first took a look at refrigerated warehouses.

So we're just expanding the efficiency standards into, you know, other areas.

And I appreciate, you know, your responsibility to help protect the lives and safety of Californians and so, you know, I appreciate your presence here and to make sure that we don't miss anything as related to health and safety. You know, it's our role to promote energy efficiency opportunities in the building codes but, of course, subservient to environmental impacts and health impacts.

So, you know, your attention to detail is really important.

And I'd also like to ask that, if possible, I would like to get a copy of the list of you think -- of the stakeholders that you feel have been left out to date. We want to make sure that all the pertinent stakeholders have an opportunity to weigh in.

So, thank you very much.

MR. SHIRAKH: Thank you, Jon.

Any other questions or comments here in the room or online?

Okay, so we're going to move on to the next topic.

MR. STEIN: I think this is like stakeholder meeting six or now, but anyway, we'll go through these slides.

We broke the kitchen section into separate sub proposals, if you will, one having to do with scope and definitions, eliminating short circuit hoods, using available transfer air, limiting the hood CFMs, is proposal four. And then proposal five is requiring energy efficiency features such as demand control ventilation or energy recovery ventilators.

Then we'll go over the proposed simulation rules for the baseline, and some acceptance tests.

So, a little bit of background. There's no current kitchen ventilation requirements in Title 24. 90.1 has had some limitations on makeup air conditioning for very large individual hoods in the past. That changed in this last version of 90.1.

And the proposal that we are putting forward in Title 24 is pretty much identical with the proposal that was just adopted by 90.1.

So, the first thing is scope and we've talked about this quite a bit already today. We'll make it clear that kitchen ventilation is not an exempt process, and then we need some terms, such as makeup air, which is defined as direct outside air brought directly into a kitchen. Then as opposed to, for example, transfer air, or infiltration. Transfer air is air from a nearby zone, such as a dining room.

Replacement air is all the air that is used to replace the air that's exhausted, so that could be makeup air, transfer air, or infiltration.

And then some other terms listed in ASHRAE 154, and we'll get to that when we talk about the max CFM for hoods.

So the first one, short circuit hoods is a pretty straight forward one. This is a type of hood that's really not actually used in California anymore, but it's been found not to work. The idea of bringing direct air, directly into the hood to make up for the exhaust turns out not to work well in practice. And that's been shown to be the case by some studies that were done by the AGA and the Energy Commission, itself.

So we did some analyses to show that a equally effective non-short circuiting hood had lower life cycle costs, when you included first cost and energy, and that was a pretty straight forward analysis.

And as we said, that's not really a common technology in California, it's used elsewhere, but we felt it was reasonable to go ahead and exclude it.

The next proposal is on condition makeup air limitations. So, the code language here would be mechanically cooled or heated makeup air delivered to any space where the kitchen hood shall not exceed the greater of, A, the supply flow required to meet the space heating and cooling load or, B, the hood exhaust minus the available transfer air from adjacent spaces.

And then we define available transfer as that portion of outdoor ventilation air serving adjacent spaces not required to satisfy other exhaust needs, such as rest rooms, and not required to maintain pressurization of other, of adjacent spaces, and that would otherwise be relieved from the building.

Again, this is the language that came from the 90.1 proposal.

And so you can -- you can still bring in outside air up to the supply flow rate required to meet the space heating and cooling load, so this could be well in excess of the ventilation minimum requirements even if you had 100 percent transfer air available.

But what you can't do is bring in air flow above the space heating and cooling loads, if you have transfer air available.

The idea here is that supplying conditioned makeup air, when transfer air is available, is a wasteful design practice and should be prohibited. And in fact it's, I would say, probably more common to use transfer air than not.

You know, in most of the chains, as we've talked about they use transfer air from the dining air as a portion of the makeup air to the exhaust system, or the entire makeup air.

Did want to point out that there was a previous version of our proposal which deviated from the 90.1 proposal, and in which case in that version we did not allow makeup air if a hundred percent transfer air was available. There were some objections to that.

We also went back and did some more life cycle cost analysis and found that actually you could justify on a life cycle -- or at least on an energy basis, not necessarily on a life cycle basis, but at least on an energy basis that you could do as well or maybe even a little better bringing in more outside air directly into the kitchen.

And so we went back and basically just toed the line and followed the 90.1 version, which allows outside air up to the heating and cooling load.

So, oh, this is just some of the language that's in the ventilation section of Title 24, just wanted to point out again that what we're proposing here is, you know, allowed by the ventilation codes and, in fact, is what's done by a large percentage of the kitchens out there today, which is to use transfer air to meet the ventilation requirements, and the code allows that, and so does ASHRAE standard 62 as well.

Wanted to also point out that the dining room would be exempt from the demand control ventilation requirements if you were to use that air as transfer air. At one point we thought we might to put in some clarifying language in the main control ventilation sections, but I think it's pretty clear, from what's already in there, that you did not -- you wouldn't have to put in a DCV system in your dining room, even though it has a high occupant density, if you're using that air as makeup air for the kitchen.

And, you know, there might need to be some guidance along those lines in the user's manual, but we think it's pretty clear from the code language today.

Just to give you some hypothetical scenarios to sort of understand what we're trying to -- what we are proposing to do here. If you can just imagine a kitchen that had an exhaust system of 5,000 CFM, that had a space cooling load that could be satisfied at 55 degree, a supply air of 2,000 CFM, had a ventilation requirement of 500 CFM, then the cooling load is typically going to be in the order of, you know, maybe two CFM a square foot, whereas the ventilation requirement is going to be on the order of .15 CFM a square foot. So, the cooling load would be, you know, often ten times or more what the ventilation requirement would be.

And in this case we sort of rigged the numbers so you had a hundred percent transfer air available, just for illustration purposes. But you can imagine you had a system that required cooling CFM of 10,000 CFM and had a high minimum outside air of maybe 5,500 CFM, and a space exhaust requirement of maybe 500 CFM, ignoring for the moment pressurization or infiltration.

So, you know, theoretically, you could transfer a hundred percent of the needed replacement air to provide the exhaust.

So, one of the things that would be allowed in this scenario is you'd be allowed to bring in, instead of just the -- instead of using all the transfer air that was available, you could bring in only 3,000 of the 5,000 of transfer air available, and still put in a dedicated outdoor system that brought in 2,000 CFM of outside air, and that 2,000 is equal to the cooling CFM.

And so you would then transfer 3,000 to make up the 5,000 difference and you'd have to exhaust the balance of what was brought in, in outside air in this system, through some additional exhaust capacity in that space.

Another system that would be allowed would be to use a hundred percent transfer air, not to bring in any direct outside air into this space. But, of course, to do this and to meet the ventilation requirements, you'd have to increase the outside air in the adjacent space to cover both the outside air in here, as well as the outside air required in the kitchen.

So, this is another option that would certainly be allowed.

The only thing that basically wouldn't be allowed under the proposal is you wouldn't be allowed to put in a dedicated makeup air system that was sized for the full exhaust rate of the hood and then have to put in a separate exhaust system for the full exhaust rate of the dining space, and not use any transfer air.

Because the amount of air you've brought in here exceeds what you would typically need for cooling for that space, alone. So, this is basically what the proposal is after.

And you see this, you know, on -- obviously, on some projects where we've done peer review, for example, it's just easy to add an exhaust fan and then add a makeup unit next to it and call it good, when you're missing an opportunity to save quite a bit of energy and first cost by downsizing or eliminating your makeup unit and using the transfer air that's available.

So that's what we're after with this proposal. And as I said, it's pretty common practice today. We'd only be going after, perhaps, the laggards in the field.

So, the next proposal -- actually, this goes through some of the analysis that we went through. I don't know if we want to spend the time going through all of it.

But one of the things that we found in going through this in more detail is if you look at the percent of transfer air, if we used a hundred percent transfer air, you know, which would be equivalent to a recirculating cooling system, only, actually uses a little bit more energy than if you brought in some more direct outside air. you know, if the choice was outside air or no outside air, there's enough times when you're getting free cooling from that outside air to make it cost effective.

But if you use an excessive amount of outside air, you know, say you used no transfer air and a hundred percent outside air, or zero percent transfer air, then you're wasting a lot of energy in excess heating and cooling of all that outside air that you're bringing in all the time.

So this is what we're after, we're trying to get rid of all of this energy use over here.

So, just some statistics on kitchens out there. I don't know if we want to get into all the details on this, this is just some background information, really.

Let's go on to the next proposal here. Air flow limitations for facilities having a total type one and type two hood exhaust air flow rate greater than 5,000 CFM, each hood shall have an exhaust rate that complies with table one, and I'll show you that on the next page. And then we give some guidance on if a single hood is installed over appliances with different duties, then you take the worst case scenario, you know, the most restrictive one or, actually, you allow the highest air flow rate. So, it's a conservative assumption here, if you had heavy duty and light duty, you would assume the whole thing is heavy duty.

And ASHRAE Standard 154 has the definitions of hood type and hood duty, and folks in this field know exactly what all the terms mean, anyway, but if you weren't in the field, you'd have to go look at Standard 154.

So here's the air flow rates in that table. For different types of hood per lineal foot, per type of duty you would, you know, look up what air flow rate you could have per foot of hood.

And these numbers were developed by the Food Service Technology Center, which did a lot of research, actually funded by ASHRAE. These numbers have all been reviewed extensively by hood manufacturers and, you know, through the ASHRAE process, these were actually developed by the ASHRAE Technical Committee for Kitchen Ventilation, so there was quite a bit of expertise involved in developing these.

We do have an exception that says you can go above these rates if 75 percent of the replacement air is transferred that would otherwise be exhausted. So, in other words, the air was going to have to be conditioned and exhausted, anyway, so you might as well exhaust it through your hood, there's no -- there's not much penalty to doing that.

So, as I said, these tables, these values -- well, were developed through an ASHRAE research project. They turned out to be 30 percent blow the minimum airflow rates in ASHRAE Standard 154 for unlisted hoods.

So, effectively what this says is for these applications, large kitchens, the lids have to be unlisted as opposed to unlisted hoods. The idea here is we're basically eliminating the practice of specifying nonlisted hoods or allowing nonlisted hoods. So, the hood would have to be a listed hood.

And from our research this should not, actually, increase the first cost and in many cases will reduce the first costs through downsizing of exhaust, supply, and cooling equipment.

In other words, you can get away for the same application with a much smaller listed hood because they can use lower CFM, so then you have a smaller makeup air system. And compare that to the cost of a larger, listed hood, the first cost is lower and the energy cost is lower, so it's an immediate payback scenario.

And that's basically what these slides show.

Our last proposal here is on efficiency measures or features. So, it says if you have a large kitchen, total exhaust greater than 5,000 CFM, you have to have at least one of the following four options. So, option A is at least 50 percent of all replacement air is transferred and that otherwise would be exhausted.

So this is only available, obviously, where you have available transfer air so, you know, that would otherwise be exhausted is basically the definition of available. So this is the kind of thing you're either born with it or you're not. You know, you have a dining facility, a dining room next to your kitchen that's large enough, or you don't. You know, or an office building, or a school, or something next to your kitchen that's going to provide that amount of available transfer air.

If you don't then you've got to follow one of the other choices. Demand ventilation systems, not only 75 percent of the exhaust air, and then there's some rules about what constitutes a demand ventilation system. But, basically, these are systems that monitor cooking process and modulate the exhaust system based on the amount of cooking that's going on.

If you didn't want to do that, you could then -- you have an option of putting in an energy recovery device. These are not common in California. Maybe in other parts of the country. We didn't spend a lot of time on this, this again was just following from the ASHRAE analysis that was done.

So, this option D is not available in the ASHRAE proposal, so this is the only deviation from what we're proposing in California to what was done with ASHRAE. But we felt strongly that it was important to allow option D because this is in fact what's done in quite a number of kitchens in California, today. Which is to say that the makeup air is not typically fully conditioned, it might be heated or -- unheated or heated to no more than 50 degrees, and uncooled or cooled without the use of mechanical cooling, i.e., evaporative cooling is quite common for kitchen makeup systems.

So we wanted to leave that as an option because if you were, basically, unconditioning or semi-conditioning this space, you couldn't necessarily justify the cost of a demand controlled ventilation system.

Frankly, we argued that point at the ASHRAE process, but there were a number of folks who felt, you know, that was encouraging a kind of technology that wouldn't be appropriate in places like Florida and, you know, other parts of the country.

But given that it's common in California, we didn't feel it was appropriate. We felt it was appropriate to allow that as an option.

The reason it's read is because the last time we gave this stakeholder meeting I think there were some comments on the exact wording of it. But, basically, the content hasn't changed since we started the process.

Here's just a picture of what a demand control ventilation system typically look like. Typically, they're using combinations of optical, as well as thermal sensing to determine cooking presence. One of the things about demand control ventilation systems is that right now a typical control strategy is just going to be on/off. Makeup and exhaust systems are either full speed or off. And the reality is food is not necessarily being cooked at all times, peak exhaust requirements not necessarily at all times, and the fans often run 24/7 to avoid fire alarms when operators forget to turn on the hoods or intentionally turn on the hoods because it makes the space noisy, or drafty, or cold or whatever.

I've seen systems that have had their ancil fire suppression system, you know, go off because an operator didn't want to turn on the hood, and then you get the fire department involved, and then the owner gets really pissed off because it costs thousands of dollars for an ancil charge and to pay for the fire department, so they lock the system on 24/7 so the operators can't turn it off when they don't want it to be on. So you end up with a system, you know, that's running at constant volume all the time, using quite a bit of energy.

And a demand controlled ventilation system has a lot of nice features that avoid that. One is that it, you know, turns down when the load isn't there. And it can also turn the system on automatically when the load comes on, so it sort of provides that fail safe capability.

So we did a life cycle cost analysis on this one, you know, the base case. So because you had four options here, we didn't feel it was necessary to show that all four were cost effective only that -- in our case we chose demand ventilation. So we said, okay, let's assume you're not born with it, let's assume you don't want to do semi-condition, that you do want to do fully conditioning because, obviously, one, option A and option D are low or no cost measures.

So we said, okay, so if you wanted to be fully conditioned, you didn't have replacement air, could you justify the cost of a demand ventilation system and we went through the analysis and were able to justify it for systems of the size that we're talking about. These are only, again, for large systems.

So, the analysis we used was actually one that was done by the Food Service Technology Center and Southern California Edison a couple years ago, looking at several actual installations where the system was either installed new or retrofit, and where they did actual energy monitoring before and after to look at the actual savings. So it's a pretty -- certainly on the energy side is a pretty accurate representation.

And on the cost side, probably pretty conservative. And, you know, I'll spare you all the details in here, but basically what we found is that we can justify it looking just at the fan energy savings, not even including the heating and cooling savings.

So if you were to include the heating and cooling savings, the cost effectiveness would obviously get even better. But looking even at retrofit applications in small systems, the payback is there. And, certainly, for larger systems, new installations, if you included the heating and cooling savings, the payback would be even shorter.

Here's some of the monitored data on energy use without and with demand control ventilation system, so the black line is before, the red is after, and the green is sort of the average of the after and you can see it's cutting energy use in half, just on the energy side, again not including heating and cooling savings.

This is a summary of some of those case studies that they went through. All of them meet the Title 24 scale requirements, again just with fan savings, without heating and cooling savings.

So, now we're on to the simulation baseline. This is the new section that we were going to put into the ACM manual having to do with kitchens. So now we're going to require you to explicitly model the kitchen separately, just like a data center is going to have to modeled explicitly separately from the rest of the building. And the baseline makeup air unit will be a hundred percent outside air direct evap unit in the baseline only if the space temperature exceeds 80 degrees less than ten hours per year.

And we didn't do a lot of analyses to figure out how many climate zones that would actually apply to. Probably not very many, if any.

but the thought is we want the baseline to be direct evap if you can maintain comfort conditions in that space, and otherwise we're going to make the baseline a DX system.

If it is a direct evap system, here's reasonable design assumptions for that system. If it's a DX system, then it will be sized for the larger of the cooling CFM or the total exhaust minus the available transfer air.

So, in other words if you had a hundred percent transfer air available it would actually be sized for the cooling CFMs, or the excess, the higher ventilation rate would be the default assumption.

And then we give some definition of available transfer air, including a assumption for X filtration on a CFM per square foot basis.

Then the total exhaust would be either the proposed case exhaust, if it was less than 5,000 CFM, in other words if it didn't trigger that maximum values table. If the proposed design did trigger that maximum values table, then you'd be compared to the values in that table. So those rates would be used if the total were over the 5,000.

So then the user would then have to put in how many feet of each hood type and each hood duty they had in the kitchen, and you'd look at that table and figure out, okay, here's your allowance, you can put in whatever you want, but that's what you're going to be compared to is what you're allowed for that table.

If the baseline does not qualify for direct evap or the 50 percent transfer air per above, then the baseline shall include demand control ventilation on 75 percent of the total exhaust.

So, basically, if you couldn't -- you know, if you weren't able to be direct evap and if the available transfer air wasn't high enough, then you'd have to model it as a DCV system to meet that one of four choices in there. And it would only be on 20 -- on 75 percent because that was sort of the cutoff in the requirement, so the other 25 percent would be modeled as constant volume and the 75 percent will be modeled as DCV.

And we've defined what the fan schedule would be for DCV, as well as the on/off schedule. In fact, we've defined, you know, occupant load and schedule, lighting load and schedule just like we have for the other occupancies in Title 24 and the simulation approach.

The last thing is the acceptance test. You know, I don't think we need to go through the rationale here. Let's dig into the details of it.

So, the first thing in an acceptance test is construction inspection, so you would basically just verify that it's all installed, powered, you know, add up the -- calculate the maximum of allowable exhaust rate for each type one hood, so you'd have to s how what you're supposed to be providing and then, as you'll see in the next step, you have to document what you actually are meets what you're required to provide, assuming you're following the performance approach, I guess. I'm sorry, the prescriptive approach.

So, here's the functional test for full load conditions, so all systems would have to apply -- run through this with or without demand control ventilation.

I don't know if I want to go through all of the details here but, basically, you actually have to simulate cooking, either using actual cooking products or using -- visually seeding the thermo plume using devices such as smoke candles, or smoke puffers and show that actual capture and containment is maintained.

You also have to verify that space pressurization is appropriate, you know, that door pressures are all reasonable, and that the exhaust rate is below the maximum allowed for that table assuming, again prescriptive compliance.

Make adjustments as necessary, measure and record the final flow rates.

So that's for all systems. Then there's an additional test just for systems with demand ventilation. And basically what the test is, not only do you have to show that it -- that system works at design, full flow, using cooking products, you actually also have to show that without cooking products the system modulates accordingly.

So, starting with the system off, turn on something on the line and bring it to it's operating temperature without putting any cooking products on it, show that the system turns on to minimum ventilation, that it maintains -- I'm sorry, minimum flow, and that that flow is no more than 50 percent of the ventilation rate, its base pressurization is maintained.

And then operate at typical conditions, i.e., apply sample cooking products or utilize smoke puffers. Confirm that the system ramped at the full speed, that it maintains capture and containment throughout and space pressurization is maintained.

So that's -- that's our whole proposal. Let me get my water.

MR. SHIRAKH: Any questions on the kitchen ventilation proposals just presented? Whoever runs to the mike first.

MS. GOLD: We appreciate the work you did with us on this and we're glad that you incorporated the thing about the override, but I didn't see in the acceptance testing, and maybe I missed it, testing that. And also a specification for how long that override overrides.

MR. STEIN: Okay. Yeah, we missed that in the acceptance testing and we will add that in.

You know, as we talked about in the conference call last week, is that my understanding on the override is that they're typically in the 30- to 60-minute range. I don't know if we need to put that in the code what the minimum is?

MS. GOLD: I think it needs to be some where in there. I just think you need to have a number.

MR. SHIRAKH: Isn't it, you know, for like our lighting requirements, when we have to use that, we typically specify the override period? And just going by that example it seems prudent.

MR. STEIN: Oh, the lighting has that?

MR. SHIRAKH: Yeah.

MR. STEIN: Okay. Well, I'll look at the lighting then and we'll follow whatever they've got in there.

MS. GOLD: And the other question I have is so DCV is not required in the dining room, but it's permitted in the dining room is my understanding. Is that right?

MR. STEIN: By this proposal? Well, we're not expressly prohibiting it, so if it's allowed by the ventilation code then I guess it would still be allowed.

MS. GOLD: So, then I think it's important to either put into the ACM or into the code that if the dining room or the area from which the transfer air is coming has demand control ventilation, you know, CO2 demand control ventilation, or whatever, that that ventilation has to be set up to ensure that the system operating as a whole, when the kitchen is operated and the dining room is, you know, virtually unoccupied, so it's at minimum ventilation rate, that should be in the acceptance testing either of the DCV for the dining room on the acceptance testing of the kitchen system. But somewhere in there you have to ensure that the modulating characteristics on the dining room aren't going to interfere with using the transfer air as a kitchen. Because just because it's not mandated doesn't mean a lot of dining rooms have DCV, whether it's mandated or not, or and schools and whatever.

MR. STEIN: Uh-huh.

MS. GOLD: So I think it's important to put that into your -- either into the code or into the ACM so that they ensure that these systems are working together.

MR. SHIRAKH: I think Mark is dying to respond.

MR. HYDEMAN: No, I agree with Deborah. I just wanted to point out that the DCV section, if you look at it, one of the exceptions we have and I think it's one that we crafted with you, was that if the air was being used as transfer air for other areas, you get an exception for the set points and control of the DCV.

So I think we already, in the DCV section, allow for what you're asking for, anyway, and I agree with you that we should do something in the acceptance test and also to make, perhaps, a cross-reference here.

MS. GOLD: Right. I know it's mandated, but we need to be sure that it's accounted for. Okay, thanks.

MR. SHIRAKH: All right, thank you. NRDC?

MR. BACCHUS: Jamy Bacchus, NRDC. I was wondering on the 60-degree set forth and if you had worked with Fisher Nickel or anyone at the Food Technology Service Center on setting the lower threshold?

Some of the projects I've done with them in the past, they were very particular on we didn't freeze the kitchen staff, and that if we ended up trying to save too much energy, they would actually not be occupying the space.

(Laughter)

MR. BACCHUS: And I was curious if you ran into that at all?

MR. STEIN: Well, so that 60 degrees was the number that was actually in the 90.1, the old 90.1 requirement for a long time. And we put it in -- I mean, that's basically sort of where it came from is from that number there. So, it wasn't a lot of analysis that came -- that went into coming up with that number.

The thinking was that, you know, it's not a mandatory requirement or even a prescriptive requirement, it's a compliance option if you didn't want to do one of the other options on that list.

You know, one of the things about a kitchen is that a 60-degree set point, if you're standing in front of, you know, a hot griddle, or a fryer, or a steamer, or whatever, is probably, you know, very comfortable compared to a 70-degree set point for example.

So I think that's probably where the number came from in the first place for the old 90.1 requirement.

You know, if we went to a higher number then I think at that point you could justify the cost of something like a DCV system. So, if somebody wanted to put in a higher set point, they're certainly welcome to, and that's why we did the life cycle cost analysis that showed you could justify a DCV system without even heating and cooling energy savings at all.

But, you know, we also, frankly, wanted to encourage people to do what's pretty much standard or common practice right now, today, which is to partially condition kitchens using evaporative cooling and, you know, low space set points in heating mode. So, I guess I'm not sure what you're -- are you suggesting that we raise that number or --

MR. BACCHUS: Potentially. It was just I had done several ECMs on a couple of kitchen projects that they were involved in and later on they came back and changed our temperature set points and our assumptions, which ended up changing the efficacy of some of the measures.

MR. STEIN: Yeah, I mean I would be hesitant to do so.

MR. BACCHUS: I was just asking if you'd essentially reached out to them or if they've been involved? I think they were on one of the stakeholder calls, but if they --

MR. STEIN: Well, certainly, they've been very involved. These seen these all along. And, you know, I think they would probably be okay with us eliminating option D altogether. But I felt -- you know, I feel pretty strongly that we should allow option D because it probably saves a fair amount of energy compared to some of the other options, and it's certainly the lowest cost option, and it's done quite commonly. And so it seems like a reasonable option to me and I think we would get pushback from the other side, you know, owners that are using that option consistently and now are going to be told they have to put in a DCV system on top of what's already a fairly efficient system.

MR. BACCHUS: I'm in favor of keeping it as well, it's more just the climate zones that it would end up including or excluding based on whatever occupancy or hours of use used.

MR. STEIN: Okay.

MR. BACCHUS: We can talk offline.

MR. STEIN: Okay.

MR. SHIRAKH: Thank you, Jamy.

Any other questions or comments on the kitchen ventilation requirements, anybody online?

So with that I'd suggest we move to the last exciting topic of the day, which is garage carbon monoxide sensors and I think Jeff's going to make that presentation.

MR. STEIN: Okay. So, garage ventilation. So, one of the things I wanted to point out was that when we started developing this measure there wasn't any language explicitly in the California Mechanical Code or the Building Code allowing CO control. There was sort of a dropout period there back in, I guess, '97 code or earlier, the

Building Code had language very similar to what you see here, today, that allowed carbon monoxide control with garages, with specific requirements about parts per million and so forth.

Then California went through a process of changing codes from the IBCs, the international codes to the uniform codes, and it got very confusing because some of the code bodies changed themselves at the same time. Anyway, it wasn't in there.

And then there was some language that sort of somewhat could have applied to it. We actually started working with IATMO, the body that writes the uniform codes, to try get it in there explicitly. We started with the language that was in the international code and they said that was too vague, they wanted more specific, so we weren't getting very far with the IATMO.

Then, lo and behold, whoever writes the California amendments to the Mechanical Code went and put back in what was already -- had just been taken out, or had been taken out years ago in this whole shuffle.

So, now it's in the Mechanical Code, explicitly, that allows CO control on garage ventilation and has set points 50 parts per million during any eight-hour period, and 200 parts per million for a period not exceeding one hour.

So, anyway, just wanted to throw that out there because that's a little bit different from what we came up with during our development process.

So this is what we have in our proposal currently, which is that enclosed parking garages with a total design exhaust rate greater than 10,000 CFM shall conform to all the following. And this is only half the list here, so there's another slide after this.

But, basically, you have to put in CO controls that allow the system to modulate down to 50 percent, and 30 percent power. And CO shall be monitored with at least one sensor per 5,000 square feet, with the sensor located in the highest expected concentration, with at least two sensors per proximity zone.

A proximity zone is defined as an area that is isolated from other areas either by a floor or other impenetrable obstruction.

CO concentration at all sensors is maintained less to or equal to 25 parts per million at all times. The ventilation rate shall be at least .15 when the garage is scheduled to be occupied. So even if you're below 25 parts per million, you still have to maintain the .15.

Systems shall maintain the garage at negative or neutral pressure relative to other occupied spaces when the garage is scheduled to be occupied.

And then we go on to add some requirements on the sensors, themselves. CO sensors shall be certified by the manufacturer to be accurate within five percent, shall be factory calibrated, shall be certified to drift no more than five percent, shall be certified to require calibration no more than once a year, shall be monitored by a control system and the control system shall automatically check for sensor failure by all the following means. Upon detection of a failure system shall reset the design ventilation rates to the design ventilation rate and transmit an alarm to the operators.

And then we have three automatic checks, it has to be running at all times. The first one is if any sensor has not been calibrated according to the manufacturer's recommendations within the specified calibration period the sensor has failed.

So, if two years go by and you didn't calibrate, then the system automatically ramps up to full speed.

During unoccupied periods the system compares the readings of all sensors. If any sensor is more than 30 percent above or below the average reading for a period longer than four hours, the sensor has failed. As soon as one sensor fails, basically they've all failed because the entire system ramps up to full speed.

During occupied periods the system compares the readings of sensors in the same proximity zone. If any sensor in a proximity zone is more than 30 percent above or below the average reading for longer than four hours the sensor has failed.

And if you'll recall on the previous slide, we said you had to have at least two sensors per proximity zone, so you'll always be able to compare sensors even when the garage is occupied.

And then we have an exception in here that says any garage or portion of a garage where more than 20 percent of the vehicles expected to be stored have non-gasoline combustion engines, so the red was added since our last conversation on this.

At one point we were considering requiring NO2 controls, where you didn't have gasoline because diesel engines don't put off CO, only -- but do put off NO2, and other bad stuff, and that's used elsewhere. And in fact that's required by the Washington Energy Code, for example.

But we decided it was not worth going after that small share of the market at this point.

So this is where we landed. Just for a comparison, you know, Oregon uses the 50 parts per million that's -- and the 200 parts per million that's consistent with the California Mechanical Code. They're using a larger threshold for size.

You know, Washington, as I said, has -- actually, they don't say what sensors to use, they just say fuel-appropriate sensors basically for non-gasoline vehicles. They're using 35 parts per million, so still above the 25 that we're proposing.

ASHRAE actually just added a requirement as well, and I think their language just says follow whatever applicable code allows you, so whether it's the Mechanical Code or the, you know, I guess it would be the Mechanical Code wherever jurisdiction.

So, you know, the idea here is that, well, first of all, most garages now have DCB. You know, there was that period where it was sort of ambiguous but, you know, we were still doing it on our projects and most others were, and certainly now that it's been reinstated in the Mechanical Code, I'm sure people will continue to do it because it does have such a good payback economically.

You know, sensors, I don't generally, but can be sold with a maintenance program and some of the sensors now do have the ability to turn themselves off if they're not calibrated.

What we've also seen is that there's a lot of existing garages that are constant volume, and a lot of these are operated at arbitrary fan schedules, you know, some assumption about when garaged cars may or may not be active in the garage.

And so what we contend is that we're actually improving health and safety in a lot of cases because systems will be actively monitoring, the system will respond automatically.

And one of the things that will change is that you won't have situations where stack effect is drawing garage effluent up into the building, because we require that the system be on at all times, that the space be maintained at negative pressure.

You know, I was at a high-rise in San Francisco, recently, where the owner said, well, we operate it for a couple of hours in the morning and a couple of hours in the afternoon, and just to be safe we had a testing company come in and do CO monitoring for one day, but they showed that the concentrations were acceptable throughout the day. And I'm just wondering, well, could that be because it was a cold day and the stack effect is drawing, you know, two CFM a square foot of stack effect right up into your building.

So, anyway, hopefully, this is going to address that kind of a situation.

We've done some work on sensor accuracy or some research and we've found that the sensors, there's basically two types, electrochemical and solid state, that have been around for quite a while in different life safety, critical life safety applications such as mining. Not the same type of sensors that are used in CO2 -- or for CO2 sensing.

There have been some studies, not a whole lot, one was done by a manufacturer that showed pretty good results. We'll show you one that we did, ourselves.

UL did a study on residential, I'm not sure how -- exactly how applicable that is, frankly.

One of the things to keep in mind, of course, is that garages typically use an array of sensors and control to the worst case as opposed to, you know, a conference room with CO2 control where, typically, you're going to have one sensor. So, now, you're going to at least have multiple sensors and, in fact, our requirement mandates that you have multiple sensors.

So, failure of a single sensor is -- you know, provides less of a risk.

The energy savings are pretty significant. This is one of our projects, where we're showing CO concentration over time. You can see the associated fan speed, fans spend almost all their time at minimum speed, but just a couple periods during the day when they have to ramp up to deal with the CO concentration.

Our energy -- our life cycle cost analysis included the cost of the sensors, the variable speed drives, the controllers on the system, the maintenance costs, including replacing, recalibrating sensors.

And we found it to be cost effective over, you know, a 6,000 CFM size garage. To be a little conservative, we set the threshold at 10,000 -- I’m sorry, 10,000 -- yeah, 10,000 CFM.

This is a study that we did, ourselves, we went to three garages and did SPAN gas testing of the sensors. In two of the garages, the sensors performed -- that we tested did quite poorly, five out of five in one garage and four out of five in the other, and failed. These are older garages, with admittedly poor maintenance records, according to the operators and so, you know, that was one of the things that led us to the level of detail in the requirements that we put together to sort of avoid these kind of situations.

The third garage that we went to happened to be one of our designs, the job -- the sensors did quite well. To be fair, these were only about two years old, but all the sensors performed very well within the stated accuracy.

So, we’ve developed some language on acceptance testing and the red was stuff that’s been changed since our last conversation, last week, I think. So the first thing we want to do is with all sensors active and all sensors reading below 25 parts per million, observe that the fans are at minimum speed and no motor demand is more than 30 percent of design, apply CO Span gas with a concentration of 30 parts per million, and the concentration accurate at plus or minus two percent, one-by-one to at least 50 percent of the sensors, or 10 percent per garage, and to at least one sensor per proximity zone.

For each sensor observe that the CO reading is between 25 and 35, the ventilation system ramps to full speed when the gas is supplied, the ventilation system ramps back down to minimum speed when the gas is removed.

And then we test all three of those fail safe sequences, control algorithms, the first one on the calibration period, so we override it to five minutes, wait five minutes, wait for the alarm to go off.

Then the second one is the unoccupied comparison of sensors, so we put the sensors in an unoccupied mode and override the 30 percent for four hours to one percent for five minutes. Chances are you're probably going to trigger an alarm with that. Wait for the alarm to come on, wait for the system to ramp up, you know, and go off.

And then, again, for the occupied sensor comparison, between sensors in one proximity zone, override it to an extremely short and tight tolerance so that it triggers an alarm, observe that the alarm is received, that the system ramps up and so forth, so that's that.

And then just like with data centers and kitchens, we're going to add in a new zone type for simulation of garages. So all the folks doing Title 24 simulation modeling are going to love us for adding all this extra work, but it's in the name of -- you know, we got to get to our goals.

Anyway, there will be a separate garage fan schedule. Well, actually, the garage schedule will follow the building schedule. If the proposed garage is less than 10,000 CFM or if the garage is expected to serve more than 20 percent diesel vehicles, then the base case garage fan power is .35 watts per CFM. This is based on one and a half total - inches of total static on the fan system and 50 percent fan efficiency.

If the proposed garage is over 1,000 CFM and less than 20 percent diesel -- I guess this probably should say non-gasoline combustion to be consistent, probably should change that.

And then we're simply going to say the base case fan power's fixed at .0044 watts per CFM. And the way we came to that was using the same one and a half inches of total static and 50 percent fan efficiency, but assuming an average fan speed of 50 percent, and just making it fixed at that level rather than adding some complexity of trying to come in on some arbitrary fan schedule.

So, that's what you're going to be compared to.

If you didn't want to put in a CO control system, you'd be compared to one with a CO control system and you could make it up with your lighting, and your glass, and your chillers and everything else, if you didn't meet the prescriptive requirements.

That's it for garages.

MR. SHIRAKH: Pat?

MS. EILERT: So, Pat Eilert, PG&E. So, a question, actually, for Mazier and Martha, last week I think Dave Goldstein made a comment to the effect that given the policy goals here in California does it make sense to be conservative on these threshold issues when it comes to energy savings?

And I'm just thinking about your 10,000 CFM threshold and you said there was a little bit of room there to go a little lower?

MR. STEIN: Right. I mean, our analysis showed at 6,000 CFM.

MR. EILERT: Yeah. So, the question is to you guys, would you prefer not to be conservative?

MR. SHIRAKH: My only concern would be if -- since this hasn't been presented to the stakeholders, if that's going to be a problem changing that number, if there's going to be some concern for some reason with going to the lower number.

But as far as we’re concerned, if it is cost effective, and it is justified, and it does not jeopardize health and safety, why not.

MR. EILERT: Thoughts?

MR. STEIN: Well, I mean, I -- personally, my opinion is that, you know, there’s always the potential for some -- someone to come in and say, well, we didn’t like your maintenance costs, and we didn’t like, you know, your first costs here or there. So I like to try to be somewhat conservative and say, okay, well, if you didn’t like that it’s still, you know, going to be cost effective where we’ve drawn the line.

The other thought here, frankly, is that I doubt there’s a whole lot of garages between 6,000 and 10,000 CFM. I mean, most of the garages I see are well above 10,000 CFM. So, you know, we could put it in but how much are we saving statewide, on an annual basis? I don’t know, probably not a whole lot so --

MR. EILERT: I was also interested in your general response when it comes to these thresholds, thanks.

MR. SHIRAKH: Okay. Jamy and then Jon.

MR. BACCHUS: Thanks, Pat. Jamy Bacchus, NRDC, I made the same comment at last Tuesday’s stakeholder meeting.

MR. SHIRAKH: Okay. Jon?

MR. MC HUGH: For the ACM part of things, I thought the ACM doesn't cover unconditioned spaces. Aren't most of these spaces unconditioned?

MR. STEIN: In California they certainly are. Other parts of the country they actually condition their garages, as crazy as that sounds.

So, you know, that might be the case, but I would argue that we should put it in because --

MR. MC HUGH: In case they are conditioned or -

MR. STEIN: No. No, no, I --

MR. MC HUGH: Oh, if they are conditioned?

MR. STEIN: I think -- well, you know, just like we're expanding the scope of the standard to cover things like data centers, and laboratories, we're talking about basically covering processes, right? So, garage ventilation is a process, right, it's not space conditioning, it's not for human comfort. We're doing this for health and safety, you know, to maintain conditions in a garage.

But there's the options -- opportunities for energy savings. I guess how do we -- the only other way around this, Jon, would be to make it a mandatory requirement. Otherwise, somebody could say, okay, well, I don't want to put it in and I'll prescriptive -- I mean go performance, but there will be no requirements in the performance. I'm not -- I guess I'm not following what you're suggesting.

MS. MC HUGH: I’m just trying to understand because, you know, historically we just -- we haven’t -- in fact, I think there’s something that specifically says that you can’t -- for instance for lighting, you can’t trade off lighting in unconditioned spaces with conditioned spaces, and I thought that unconditioned spaces were specifically not included in the ACM so that there wasn’t tradeoffs between conditioned spaces and unconditioned spaces.

This would be a change in that sort of global rule set, so I just wanted to raise the issue so we’re thinking about it, you know.

MR. STEIN: Uh-hum.

MR. MC HUGH: So, I guess the idea would be that if you wanted to not have a control -- you know, basically a CO control, then you could do this by improving the efficiency. So I guess you don’t have the situation -- do you have the opposite situation, too, that if someone has a super-duper fan or something, low-pressure drop fan that you now could then --

MR. STEIN: Right.

MR. MC HUGH: -- take credit for that low-pressure drop fan to now reduce the chiller efficiency or whatever in the building?

MR. STEIN: Yeah. So, to answer that -- your last question there, the answer is pretty much no, because when you get down to .044 watts per CFM there's nothing left. Right? We're basically saying you're -- you know, yes, it is based on one and a half inches of static and 50 percent fan efficiency, and you could come up with a system that had, you know, .75 inches of static at design and, you know, 80 percent fan efficiency.

But .044 is, you know, one-eighth of the design fan power, right? And so there's so little energy left there to be saved there's nothing to -- you know, there's no way to game the system at this point.

MR. MC HUGH: Okay, I just --

MR. STEIN: So, really, what this does is basically just says if you didn't want to put it in, you're going to be compared to somebody who did put it in and you got to make it up somewhere else, so your chillers have got to be better, not worse.

MR. MC HUGH: Right. Okay.

MR. STEIN: So I don't see a lot of loopholes here that we've created.

MR. MC HUGH: Okay, thanks.

MR. SHIRAKH: And Deborah?

MS. GOLD: Deborah Gold, CalOSHA. Again, thank you for working with us on this proposal. We still have a couple of concerns -- by the way, one thing, when you were talking about the cost of the proposal, I didn't see in here the cost of maintaining a trained workforce who would know how to calibrate this equipment and run it, and I think that should be considered as a cost here because one of the biggest problems we've encountered in this type of system is that the people in the facility don't calibrate the sensors, they don't even have a clue as to how they would.

So, it's not just the cost of the gas cylinder, which is mentioned in here, it's also having those people who are capable of doing that.

So, maybe that ups that from 6,000 square feet up to 7,000 square feet where this is cost effective, so there you go.

But I do think it's important to recognize that these systems are only going to work so long as there's a trained workforce to maintain them. And it is unfortunately true that that is rarely there.

We have a couple of remaining concerns, one is the -- we liked the -- we like that you're trying to figure when the sensors have stopped working. But on number C, 5.c here, it says during occupied periods the system compares the readings of the sensors in the same proximity zone. And then it says if any sensor is more -- is more than 30 percent above or below the average reading, which I assume means for that proximity zone, for a period of longer than four hours then the sensor has failed.

And I think there's a problem here because what we have is intermittent operation of vehicles that are causing momentary increases in CO. And so four hours is a long period -- I could have a completely dead sensor and at least part of that time it's going to read the same as the other sensor, because they will both be sitting down there around zero. If nothing's been started up in that area -- during a four-hour period in a parking garage is a long time. And parking garages -- well, in a shopping area that may not be so true. In a parking garage that caters to people who park in the morning and unpark in the afternoon there is a long period of time during which no vehicle or one vehicle may be operated.

So you are going to be in concordance hanging around zero for most of that four-hour period, and then for a couple of hours it may go up. So if all I'm looking at, if I have to be discordant by 30 percent for four hours to detect, essentially, a fan failure, then I don't think you're going to pick it up.

And I think you either need to have a smaller period, or a different system, or maybe you just need a rule that if a sensor hasn't read above 20 or whatever in a 24-hour period, it's probably a dead sensor. It's either a dead sensor or one that bears investigating. Because in any parking garage you're going to have those -- and I don't care if you set it at 20, I mean there's probably a number. But you need to know that -- you need to know that the sensor isn't just dead.

And in relation to that, the other big concern that we have -- that we still have is that in the acceptance testing you're saying that you only have to calibrate half the sensors or, rather, field test half the sensors to make sure that they are reading the gas at 30 parts per million.

And I think that's a mistake because we're relying on that other sensor to show when the other sensor has failed. So, if there are two sensors sitting in a pair, in an area this size or larger, then if I've only calibrated one, then I don't know what's the performance of the other one. And, therefore, when this one fails, the one who I calibrated, I don't know that the other one hasn't already failed, and so we're not going to pick them up, again, as proximity readings.

And since the unoccupied period, the other way we're picking up a failed sensor, in actuality, is during the unoccupied period when the emissions are -- should be -- you know, you should be sitting pretty close to zero carbon monoxide or a couple parts per million carbon monoxide, you're not going to pick that failure up, either.

So I think you need to rethink -- I think, one, that every sensor, as long as you're there with the canister and the trained person, you might as well field test every single sensor as part of acceptance testing, then you know you have two good ones.

So, when one fails, you'll have the other one to pick that up.

And then the other thing is to change the way that that last proximity sensor comparison is being done so that you will be sure to pick up a dead sensor. And I think either really shortening the time frame or sending a level that you expect every sensor to read above, if it's in that area, since they're already being placed in the area where it's -- in the portion of the 5,000 square foot zone where you're expecting the highest -- I mean that's a requirement, that you're going to place the sensor in the area of the 5,000 square foot zone where you're expecting the highest exposures so -- or the highest concentrations.

So, one would expect then that that sensor will span to something over some 24-hour period, and that may be a better way to approach it. I'm not saying for sure that is, but I don't think that this comparison's going to work out if you're doing a four-hour period and they're allowed to deviate by 30 percent. So, that's what we have to say.

And, Mazier, I had a question for you. There was something put in the last time we did -- that we had this happen, where the Building Standards Commission put in something in the Title 24 Mechanical Code that was then less protective than what we were fighting about here, and they put in a thing that said you also -- a sentence that said you also have to refer to -- what is this part, whatever, the Energy Code. To the Energy Code, part 6, and that was put into part 4. Is that still there?

MR. SHIRAKH: Yeah, it is. You're talking about --

MS. GOLD: You remember, we were talking through this about some ventilation rate or another?

MR. SHIRAKH: The Mechanical Code uses ASHRAE rates.

MS. GOLD: Right, they were using an ASHRAE rate that had an ASHRAE table in, and then there was a note put in that said --

MR. SHIRAKH: You have to --

MS. GOLD: -- they have to also comply with this.

MR. SHIRAKH: With this, yeah.

MS. GOLD: And I'm wondering if that note still exists and if that can't be used to deal with the fact, because 25 parts per million as an eight-hour time weighted average is California's principle exposure limit, and that also recommended by a number and that also recommended by a number of other agencies, and it was based on excess cardiovascular problems that were found at a Berkeley parking garage. I mean, so it was lowered in part in California because of those very exposures.

And 200 parts per million as a one-hour average is just too much, so it's a -- that's our ceiling never to be exceeded. So, once you got to 250, you would be well over it at that moment.

So, we need to fix whatever happened in part four, but in the meantime if we could check and see if that notes is still there in that --

MR. SHIRAKH: As far as I know, it's still there. No, we haven't asked it be removed or anything.

MS. GOLD: Okay. All right, thanks.

MR. SHIRAKH: Thank you. And I must say that, you know, this garage language, working with you has really helped to make it a much, much better proposal.

MS. GOLD: I think that's right. I think Jeff, and Mike, and Bob also put in a lot of work on this.

MR. SHIRAKH: Yeah, thank you.

MS. GOLD: And we appreciate the cooperation.

MR. SHIRAKH: Jeff, do you want to briefly respond to the three points that she --

MR. STEIN: Yeah, I mean, so the trained workforce, the numbers we got in there were for sensor manufacturers to do the calibrations, themselves. You know, they sell maintenance programs and they'll come out and do it. So the thought was, you know, these are people, that's their job, they do it all day long. So, this is what they're telling us it's going to cost them to come into your garage and do the calibration, so I think I'm pretty comfortable --

MR. SHIRAKH: And did you include those costs in your estimate?

MR. STEIN: Yeah.

MR. SHIRAKH: Okay.

MR. STEIN: So I'm, you know, pretty comfortable there. The question about acceptance testing, you know, only 50 percent, I think -- I think that we did that because when we had done our analysis we didn't have redundant sensors, basically, and we were thinking, well, I'm not sure we can necessarily justify this added costs, what is that going to do to our life cycle cost analysis. You know, sort of going back to the question of, well, do you want to -- you know, how aggressive do you want to be in your analysis?

We did hear from one of the manufacturers on that call last week that, you know, they test all their sensors. I hadn't gone back and checked with other manufacturers. So, you know, I think that's something that we ought to look at is to see what is -- is it really going to cost much to do all the sensors or not?

MS. GOLD: Well, how much --

MR. STEIN: We're going a little further in this acceptance test in that manufacturers typically are just testing each sensor, we're testing each sensor and observing that it's tied to the ventilation system and that the ventilation system goes up and down every single time. So, maybe we'll break it up and say you have to test every sensor, but you only have to test the entire ventilation system, you know, with some fraction of the sensors or something like that.

And then the last one about the fail safe language, the 30 percent for four hours, I -- I think we're going to get into it that it will really backfire on us if we try to go tighter on this because it's already pretty tight. And if it gets a whole lot tighter, you'll have a lot of nuisance trips and then you'll have folks defeating the system. Because here they are spending all this money to put in a demand control ventilation system and it isn't running because we get all these nuisance trips, and so they're just going to defeat it and it will run all the time. So I, actually, would like to leave it the way it is.

You know, when a sensor fails, you know, those garages we tested, they were 12 years old, so they had probably failed ten years ago.

So when you compare, you know, four hours to ten years, you know, I feel like we're providing pretty reasonable coverage.

MS. GOLD: No, you're missing my point. My point is not that it has been failed for four hours, my point is that you're not going to pick up the failure with the algorithm you've got.

That the -- I've got two sensors sitting here.

MR. STEIN: Right.

MS. GOLD: This one doesn't span, this one does.

MR. STEIN: Right.

MS. GOLD: Okay. So, I mean, because we've calibrated both of them. So this one -- so this one fails.

MR. STEIN: Right.

MS. GOLD: Okay, so we're sitting here and you start up a car and this one momentarily goes to 12, and this one stays at zero and this one goes to 12 --

MR. STEIN: Right, so it's going to come up --

MS. GOLD: -- and that keeps going on for four hours. But eventually this one comes down to zero, periodically during those four hours, because there aren't cars starting up by that sensor every time.

MR. STEIN: Right.

MS. GOLD: So that we never pick up the fact that this one isn't spanning anymore. We don't pick it up in four hours, we don't pick it up at any point until whenever, there's no check on the span.

MR. STEIN: Well, we have the -- we still have the after-hours check so it --

MS. GOLD: No, because the after-hours check everybody's going to be at zero.

MR. STEIN: Right. But basically what you're saying is that the concentration's never going to be high enough in a garage. If the concentration never gets up in the garage --

MS. GOLD: That's not what I'm saying. I'm saying that it's not going to remain high for four hours, and it's not. I've gone in an awful lot of parking garages with CO meters, it doesn't remain high for four hours. There's a periodicity that may not be true at the Metreon Parking Garage, okay, but for a large number of other parking garages there are periods of an hour, or two hours where cars are starting up or being parked, and then everything's dead. It's in the hours of operation, but the damn thing's full of cars.

And then they start up again for less time, even, because in the afternoon people are just like, boom, out of there.

MR. STEIN: Right.

MS. GOLD: And by six o'clock it is -- so that's my problem, it's not that I wanted to be tighter, I want something functional.

MR. STEIN: Okay. I'm sorry, I misunderstood your -- or I didn't -- I wasn't following the whole thing.

MR. SHIRAKH: She actually had a suggestion that if a sensor doesn't respond within 24 hours to anything, then we can assume it's dead.

MS. GOLD: It's dead. I mean, that may be better, if the thing never goes above some level, whatever that level is -- I mean, 25 seems obvious because that's the level we're going to trigger at, but if you don't think it's going to reach 25, say if the sensor never goes to 15 --

MR. STEIN: Right.

MS. GOLD: -- you're going to consider it dead. But it's the way of detecting a sensor who doesn't span. You know, otherwise you don't have a way you're going to pick up a sensor who doesn't span.

MR. STEIN: Okay. Yeah, no, I understand. I think we -- we'll definitely want to look into that some more. I mean, you do have to be careful not to create nuisance trips because then people start defeating systems but, you're right, we probably ought to come up with something that --

MS. GOLD: We need some way because the fact is that, yes, you guys picked up something 12 years -- a building 12 years old, but somewhere in the two- to 12-year period a lot of these sensors fail.

And so if we -- I understand you've got to pick up if the sensor hasn't been calibrated, but the fact is we have -- we use CO sensors all the time in our business. I mean, we're -- they're a stock in trade in CalOSHA, and parking garages are part of our stock in trade.

So we know that those CO sensors fail and they often fail without much warning, and they have a lifetime, and they get poisoned by this and that I mean, you know, all that stuff.

So all I'm saying is you need a way to make sure those sensors are still spanning, and whatever way it is, this one isn't going to be it.

MR. SHIRAKH: Okay.

MR. STEIN: Okay.

MS. GOLD: Thanks.

MR. SHIRAKH: Okay, thank you, that was good comments.

Any other comments related to the CO sensors in garages, here or on the phone?

Any other comments related to anything that was presented today, morning, afternoon, or anything related to the building standards, or American Idol, whatever you want to talk about?

So, I guess with that I'm just going to remind everyone that there's going to be another Nonresidential Staff Workshop that's going to be next Monday, and that's going to be Martha's show. We're going to present a bunch of nonresidential topics, and I think I listed them this morning.

And then there's going to be another Nonresidential Workshop on the 27th, and the last Nonresidential Workshop on the 5th of May. And again, my slide presentation is going to be online, and the next to the last slide has the list of all the workshops and the topics that are going to be presented, so you don't have to take lots of notes.

Yes, Deborah? When do these proposals come back up? Actually, we're not planning to have other workshops on anything that we're presenting here in these topics, but we will be working with stakeholders just like we have.

And then the only time these are going to come up again are going to be late in summer, where we present the draft standards as a whole, and then after that when we're going to the 45-day language.

So they will be coming up again, but to work through the issues that you brought up today, we will be working with you in our stakeholder meetings, like we have been over the past several months.

And then to continue, you still seem like you have a question, did you -- can you -- he needs to pick you up.

MS. GOLD: Some of these proposals seem pretty much progressed along, and some of them, like the lab one, have a lot of stuff that hasn't been fleshed out, yet, so I'm a little bit concerned that there isn't going to be a scheduled workshop on this. Like it seems like the garage ventilation one, it's true, there's a little bit of work that needs to be done in some of the language, but I think we kind of seem relatively okay. I think we're getting that way with kitchen ventilation.

I don't feel that way about the lab hoods, I feel like the lab hoods thing is a mess.

MR. SHIRAKH: I think we understand that and, again, you know, you've been involved in the stakeholder meetings and that's -- those are the working meetings where we really try to flesh out the differences, and we will have some of those. And, you know, we have the transcription of these -- today's hearing is going to be available, in about ten days, a week, two weeks or something, so we have your comments and we will be running them by you again.

And we're not going to sneak anything by you.

MS. GOLD: Yeah, I mean our -- part of our concern is this, is that we're in contact with some stakeholders who want us to tell them, well, what's the meeting, what's the phone call you want us to be on because they're -- you know, like the unions have limited resources to put into this.

So, I guess what they're looking for and what I'm trying to find out from you is where can they get their voices heard most effectively, with the smallest amount of energy put out, frankly, on their part, because they have limited resources, unlike us.

MR. SHIRAKH: You know, the thing I offered you today to give us either the list of those stakeholders that we can directly contact, or you can forward our messages to them.

But what we will commit in doing is that give you enough -- enough warning for the meeting so that, you know, you'll have time to prepare and engage the other stakeholders.

Mark, did you want to say something?

MR. HYDEMAN: Yeah, so Deborah, I would also encourage you to encourage them to send written comments. Because if we have written comments, we can try and address the written comments directly. If we wait until a workshop, it's probably too late. You know, usually in a workshop we're presenting results.

Hopefully, we get this feedback -- we put stuff out there for review and comment. You guys have, for instance, given us the language about Title 8, it was very helpful to have something that we can look at and address. I can now go out and get those sections of Title 8, I can send them out to other participants, get feedback, and try and to decide what the right way to deal with that is.

So, if you could ask these people that, you know, they're saying how can we get our input in, it would be very timely if they could send us written comments, e-mail or, you know, send us a letter, or send them through you.

MS. GOLD: I mean, I have to say is their problem is that they want -- they want to take one whack at it, they don't want to -- they're not able to do a continuous participation. So I'm just trying to find out what the deal is.

I understand that you would like to have ongoing communication with them, so would we, but that's not how it's going to happen.

But, anyway, if you can just keep us in touch, we'll try to keep people informed, and we certainly provided contact information to different unions, and if it's not on your list, it's because they've chosen not to be so --

MS. BROOK: And I think we can try to schedule something, you know, as a web meeting, like we have been doing, once -- once we've worked through more issues with you on the lab stuff, and bring the stakeholders in to say this is -- this is looking like our final proposal, we're either going to do it or we're not.

MS. GOLD: Okay. It seems like if we could get about three to four weeks notice of a web meeting like that, we could put that out to those people who haven't -- they're not involved in ASHRAE, they're not involved in any of this other stuff so -- okay, thank you.

MS. BROOK: Thank you.

MR. SHIRAKH: Thank you. Any other -- and then to finish my thought, then the last Nonresidential Workshop is going to be on the 5^{th}, and then we're going to have three Residential Workshops in late May and early June.

So, with that I'm going to thank everybody and we'll see you next week, same place, same time. Thank you.

(Thereupon, the Workshop was adjourned at 3:39 p.m.)

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